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THIRD SERIES FOUNDED BY EDWARD JACKSON

CONTENTS

For a complete table of contents see page xlvii

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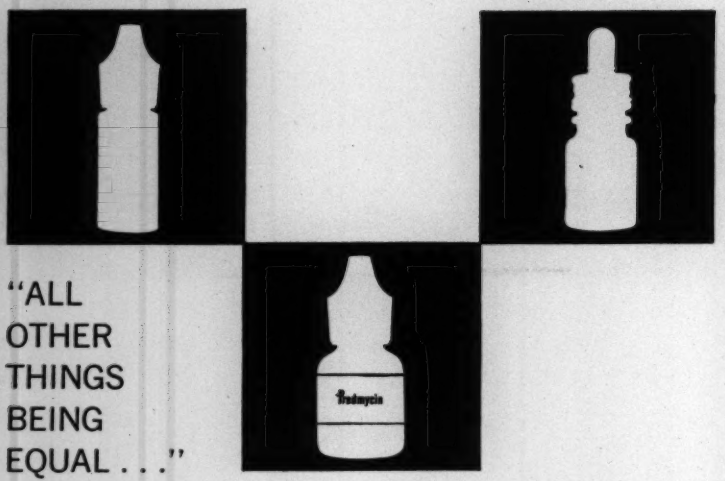

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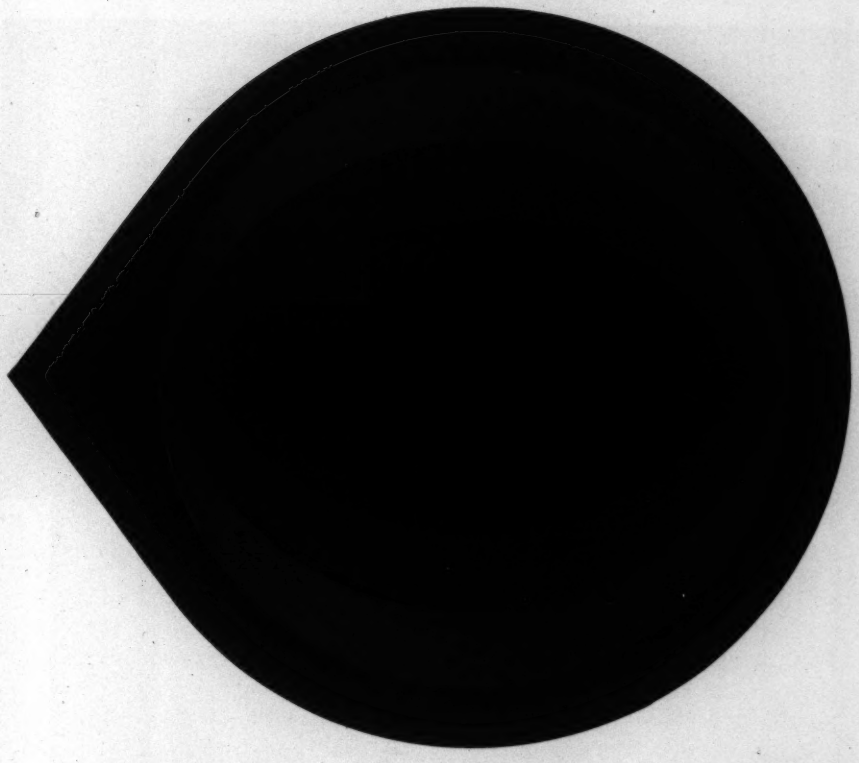
4 days after treatment



THE DRUG THAT REDUCES INTRAOCULAR PRESSURE EVEN IF MIOTICS AND CARBONIC ANHYDRASE INHIBITORS HAVE FAILED

Indications: UREVERT has proven to be extremely effective in reducing intracranial pressure preoperatively and postoperatively, irrespective of cause. Recent evidence shows that UREVERT will reduce intraocular pressure even when miotics and carbonic anhydrase inhibitors fail. It has been used with success in acute angle closure glaucoma, preparation for intraocular surgery, retinal detachment surgery, orbital surgery.

Dosage: Intravenously, one gram urea per kilogram body weight at rate of approximately 60 drops per minute.

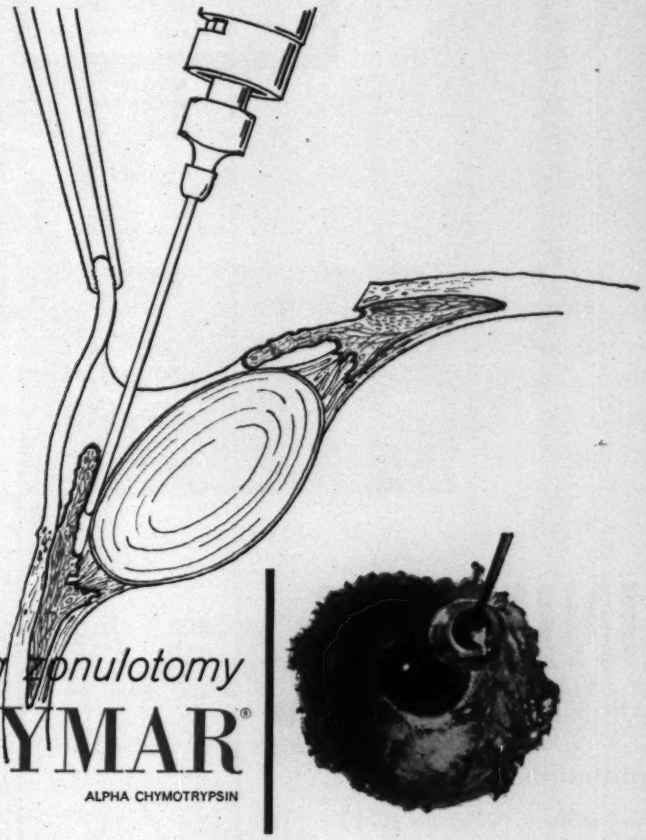
Repeated Administration: 1. Careful recording of fluid intake and urinary output. 2. Maintain a positive water balance. 3. Maintain electrolyte balance and observe B.U.N. *Note:* In all cases under general anesthesia an indwelling catheter is necessary.

Contraindications: 1. Severe renal damage. 2. Active intracranial bleeding. 3. Marked dehydration.

Caution: 1. Keep needle securely within lumen of vein to avoid extravasation. If pain at site of injection, relieve by injection of 0.5 cc. of 1% procaine through same needle. 2. Lower extremity infusion in older patients.

Side Effects: Headaches may occur in patients with normal intracranial pressure from marked lowering of intracranial pressure. Keep patient flat in bed for duration of UREVERT administration and subsequent 2-3 hours.

REFERENCES: 1. Fremont-Smith, F., and Forbes, H. S.: Arch. Neurol. & Psychiat. *18*:550 (Oct.) 1927. 2. Javid, M., and Settlage, P.: J.A.M.A. *160*:943 (March 17) 1956. 3. Javid, M.; Settlage, P., and Monfore, T.: Surgical Forum *7*:528, 1957. 4. Javid, M., and Settlage, P.: Tr. Am. Neurol. A. 1957, pp. 151-153. 5. Javid, M., and Anderson, J.: Surgical Forum *9*: 1959. 6. Javid, M.: Surg. Clin. North Am. *38*:907 (Aug.) 1958. 7. Javid, M., and Anderson, J.: J. Lab. & Clin. Med. *53*:484 (March) 1959. 8. Stubbs, J., and Pennybacker, J.: *Lancet 1*:1094, 1960. 9. Tench, J. H.; Javid, M., and Gilboe, D.: Anesthesiology *21*:117 (Jan.-Feb.) 1960. 10. Javid, M., and Davis, M.: Scientific Exhibit No. 922, A.M.A. Annual Meeting (June) 1960.



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1. Cogan, J. E. H.: Proc. Roy. Soc. Med. *51*:927, 1958. 2. Jenkins, B. H.: South. M. J. *53*:44, 1960; discussion by Raiford, M. B. 3. Raiford, M. B.: J.M.A. Georgia *48*:163, 1959. 4. Rizzuti, A. B.: A.M.A. Arch. Ophth. *61*:135, 1959. 5. Thorpe, H. E.: Am. J. Ophth. *49*:531, 1960.

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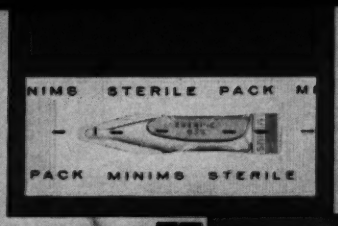

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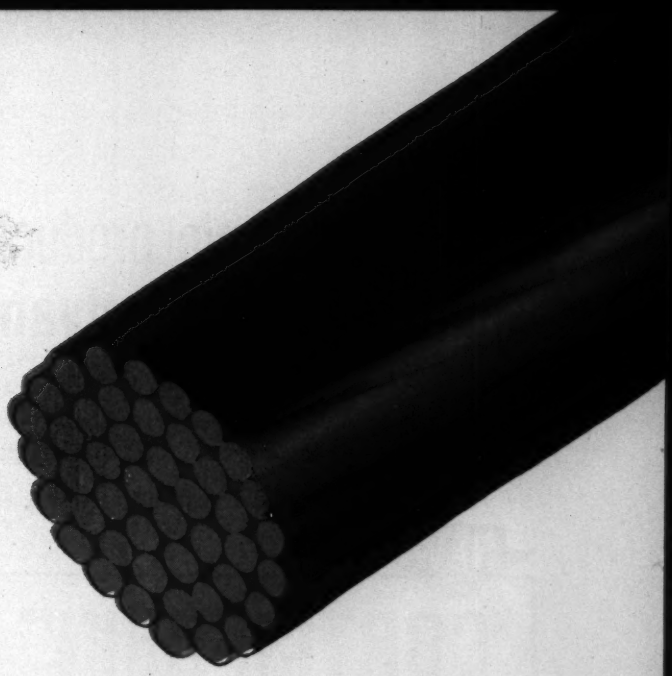

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•long-acting—in glaucoma, one instillation daily is often sufficient; (in strabismus, one instillation every two days to one week) •may be effective when other agents fail •two topical dosage forms—0.1% ophthalmic solution in anhydrous peanut oil, in 5-cc. bottle with dropper; 0.025% ophthalmic ointment, in 3.5 Gm. tubes

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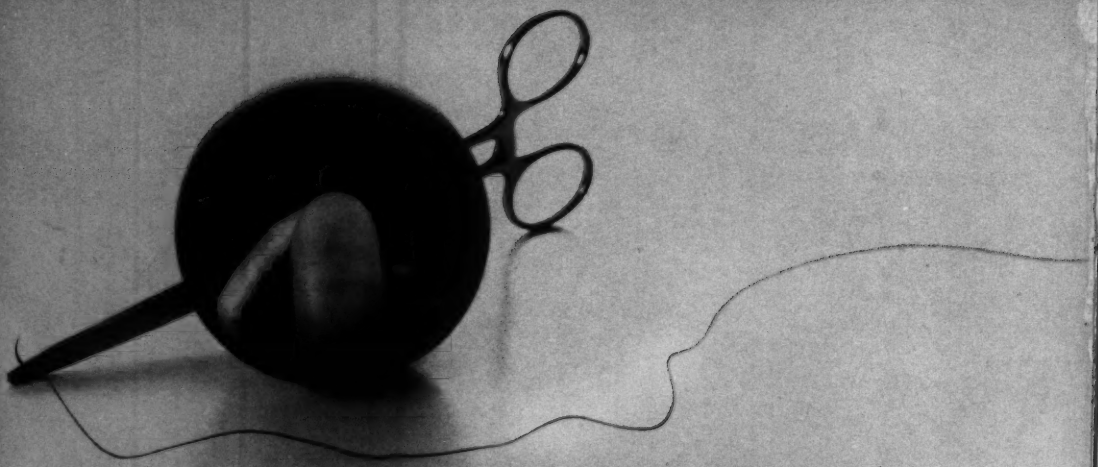

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NEW HIGH TENSILE SURGICAL GUT—absolute uniformity of entire strand ensures greater knot and tensile strength. Satin matte finish creates a highly pliable suture strand with excellent knot-holding characteristics. Carefully controlled chromic processing maintains in situ gut strength during wound healing. Rigid laboratory digestion tests assure a uniform rate of absorption and compatibility with tissue. Also available are DERMALON® Monofilament Nylon and SURGILON® Braided Nylon sutures.

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Consult literature and dosage information, available on request, before prescribing.

Gantrisin Diethanolamine Ophthalmic Solution and Ointment contain 4% Gantrisin®—brand of sulfisoxazole.

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When a straight-top bifocal is indicated, Orthogon ST bifocals give the patient the added value of Orthogon marginal clarity, Orthogon focus and surface qualities, and the benefits of Orthogon Nokrome crown and barium glass combination. To fit all needs, you get a full range of ST segment sizes—20, 22, 25 and 28mm in width.

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There is an Orthogon ST lens for every straight-top need—bifocal and trifocal—and in a wide range of adds and base curves in white, Soft-Lite and Ray-Ban 3 and G-15. Double segment bifocals, with 22mm upper and 22, 25 or 28mm lower. When a straight top is indicated, prescribe Orthogon ST bifocals and *know* you're granting the best!

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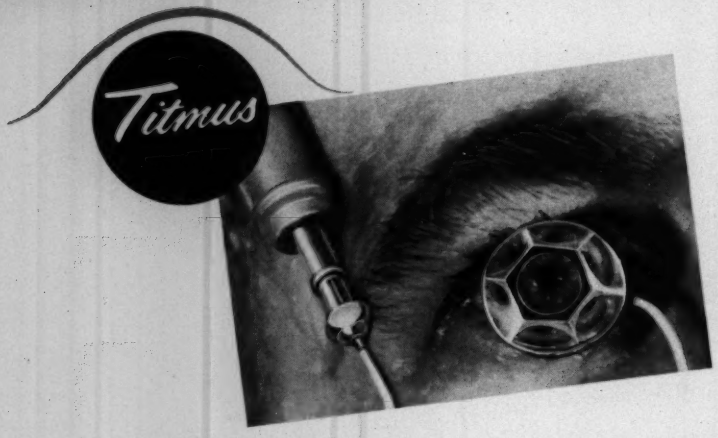

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No more tedious holding of diagnostic lens by hand! No more bubbles between lens and cornea! Unique vacuum retention system easily supports and keeps lens in contact with eye. Eye, head, or body movements do not disturb; lens follows the eye in every direction of gaze. Frees hands. Permits examination with patient in sitting position. Examination causes no fatigue for doctor or patient. Exact centering is easily maintained. Rotation around the limbus is easily done. Lens removal is simple; it drops off when vacuum is broken at bulb.

All these advantages over the conventional diagnostic lens are made possible by Titmus LoVac Diagnostic Contact Lenses, developed in Holland, and manufactured by the Medical Workshop of that country, exclusively imported and warranted in the U. S. by Titmus.*

The slight vacuum is produced by a miniature rubber bulb operating via a flexible tube and a steel capillary through the plastic lens. The special optical plastic is precision ground and polished—not cast or molded. Permanent transparency and stability of color are assured.

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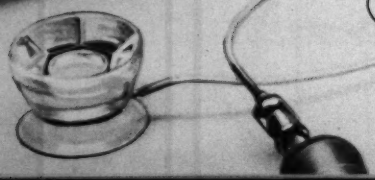

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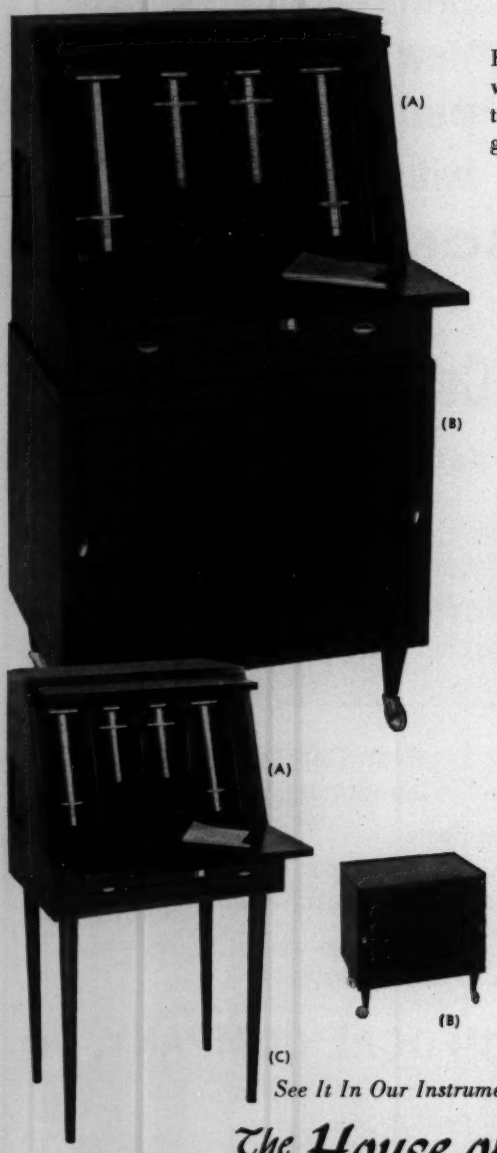

Here is an illuminated lens cabinet ensemble whose compact convenience is designed to adjust to almost any office space. Modular styled in grained walnut or light birch finish.

- Lens cabinet (23" wide x 21¼" high x 15½" deep at bottom) accommodates any size trial lens tray; One drawer—20¼" long x 13¾" wide x 3⅛" deep (inside). Back panel is screw mounted for easy removal.
- Lower part of protective divided lid swings down to provide firm, Formica-topped writing surface. Upper part retracts into cabinet.
- Decorative square panels, both sides, are designed to accommodate H.O.V. All-Purpose Transformers with telephone off-on switch instrument hangers.
- Illumined by 12" fluorescent pencil tubes, shielded to prevent glare. Automatically turn on and off by opening or closing top lid.
- May be wall-mounted, set on matching storage cabinet or mounted on attractive legs, with or without casters.
- Lens cabinet (A) when used with storage cabinet (B) fits down into ¼" flange around back and sides which provides safe, non-sliding bond between two pieces.
- Storage cabinet (B) has sliding doors for easy access —and a removable, adjustable shelf. When used as extra cabinet, glass top can be provided.

Catalogue No.

HV 4707	*Lens Cabinet (A)	$115.00
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HV 4709	*Set of 4 legs, with casters— 24" high (C)	$ 18.00
HV 4710	Glass Top For Storage Cabinet	$ 15.00

*Specify grained walnut or light birch finish.

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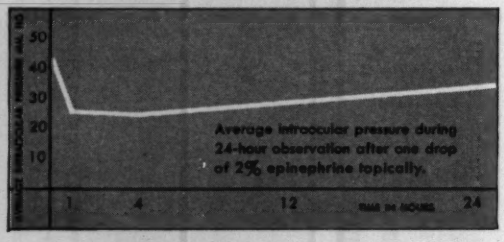
for chronic, open-angle glaucoma

Garner, et al., recently studied the effects of GLAUCON Ophthalmic Solution (epinephrine HCl 2% in a new stable vehicle) on intraocular pressure in open-angle glaucomatous eyes. GLAUCON proved to be so highly effective that the investigating group summarized[1]:

"GLAUCON has a valuable place in the medical armamentarium of the ophthalmologist . . ." and, "it has specific advantages in the treatment of open-angle glaucoma since it rarely produced intolerance in almost three years of observation."

the results with GLAUCON *were reported[1] as follows:*

1 "The topical application of 2% epinephrine [GLAUCON] to 44 glaucomatous eyes under no other therapy and of the chronic, simple type results in a drop in the intraocular pressure ranging from 3 mm. Hg to 38 mm. Hg with an average of 13.5 mm. Hg."



2 "The removal of epinephrine [GLAUCON] topical therapy from 43 eyes previously stabilized and normalized on combined therapy [GLAUCON and a miotic] and permitted to be without this medication for a period of seven days results in a rise in the intraocular pressure ranging from 4 mm. Hg to 31 mm. Hg with an average rise of 11.7 mm. Hg. It is in this group that the greatest number of satisfactory results were noted . . ."

"The patient that is difficult to normalize on miotics and who remains in the vicinity of the mid-to-upper twenties tends to reveal the best results, insofar as the tension can now be easily maintained in the low or below twenties on one or two applications of epinephrine [GLAUCON] per day. As a result, this type of patient has been able to reduce the frequency of miotic therapy so that in some instances medication need no longer be carried, since morning and evening application of both miotic and 2% epinephrine [GLAUCON] was sufficient."

3 "Of the entire total of 219 eyes in this series, 69, or 31%, were not controlled by any means, while 21 (9.5%) were controlled on epinephrine [GLAUCON] alone and 54 (24.6%) more by combined miotic and epinephrine [GLAUCON] and an additional 35 (15,9%) when a carbonic anhydrase inhibitor was added."

Since miotics alone controlled 40 (18.2%) eyes, GLAUCON effectively aided or controlled tension in 61% of all eyes in which it was used. It controlled or helped control 79% of chronic, simple (open-angle) glaucomatous eyes.

4 "Tonographic studies gave evidence that the best results (91%) in significantly lowering intraocular tension occurs in those cases whose coefficient of outflow is 0.15."

5 Dilatation of the pupil was noted in all patients not under miotic therapy. Two patients had orbital pain which remained for about two hours. Two other patients developed marked hyperemia associated with moderate epiphora but these disappeared promptly after withdrawal of epinephrine.

GLAUCON has been proven to be effective in normalizing chronic, simple, open-angle glaucoma. In cases resistant to miotic therapy it effectively reduces tension alone or when combined with the miotics. Suggested dosage is one drop in eye(s) per day or as indicated.

Use and prescribe GLAUCON in your practice. GLAUCON is supplied in sterile, 10 ml. bottles with a sterile dropper assembly. All drug wholesalers now have GLAUCON in stock. Your pharmacist can supply it promptly.

GLAUCON CAUSES LITTLE IF ANY PAIN OR STINGING UPON APPLICATION. CLINICAL EXPERIENCE CONTINUES TO DEMONSTRATE HIGH PATIENT ACCEPTANCE AND GENERAL AVOIDANCE OF DISCOMFORT.

1. Garner, L. L.; Johnstone, W. W.; Ballintine, E. J.; and Carroll, M. E.: Effect of 2% Levo-Rotary Epinephrine on the Intraocular Pressures of the Glaucomatous Eye. A.M.A. Arch. Ophth. 62:230 (Aug.), 1959.

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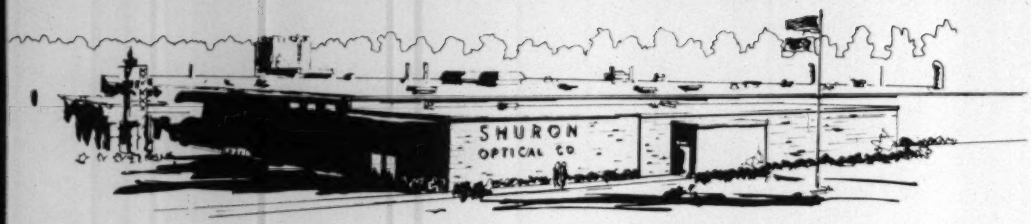

SHURON OPENS NEW WIDESITE LENS PLANT AT BARNWELL, S. C.

Shuron Optical Company is investing 3.3 million dollars in the expansion of their lens-making capacity. That is the cost of the new Widesite lens and Shuron case plant at Barnwell, South Carolina.

The Barnwell plant is the answer to a need for lenses of Widesite quality expressed in the growing demand for Widesites. It is the result of the efforts of many men experienced in the optical field, some who have devoted their lives to it. They have helped to design and build the first new lens plant in the continental United States since before World War II, using modern applications of electronics and hydraulics never before possible.

Nestled in the green South Carolina forest, the new plant is impressive both outside and in. It covers 183,000 square feet, with over 4 acres of floor space. The central section, the main working space, consists of a huge square building 400 feet on each side. No windows; everyone works in an atmosphere of comfortably controlled light and temperature which also helps assure the accuracy of the close-tolerance processing.

Inside the plant, the cleanness, brightness, and orderly air of efficiency are striking. One problem well solved is the delivery of slurry and coolant to the machines, which is done neatly and directly through a system of tunnels. The entire plant was laid out in a logical, continuous line so one operation follows another in a smooth, timesaving flow.

There is also room for expansion at Barnwell. Plans for the future include manufacture of multifocal and plastic lenses at some not-too-distant time.

Barnwell is a pleasant, hospitable southern town 60 miles south of Columbia, the state capital, and 40 miles east of Augusta, Georgia . . . right in the heart of the industrial expansion of the modern South. The welcome and cooperation of the townspeople and those of the surrounding area has been most helpful and gratifying.

We are extending to you an invitation to visit the Shuron Barnwell plant to see how the new plant facilities will assure the continued quality of Widesite lenses.

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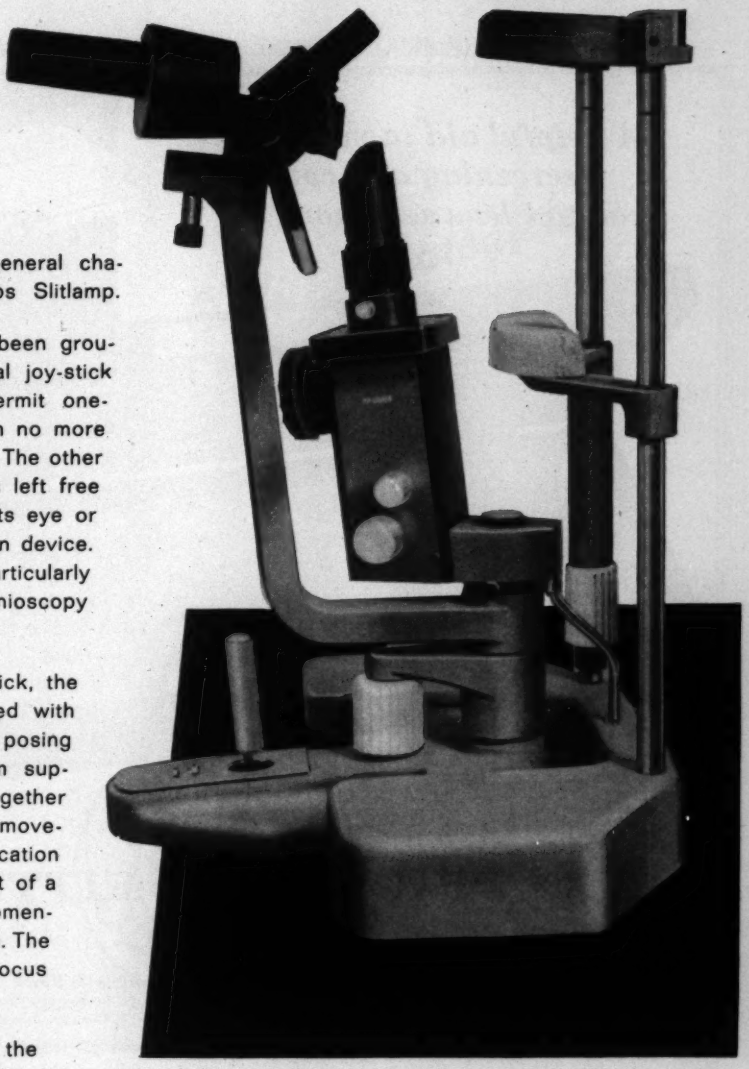

HANDINESS is a general characteristic of the Gambs Slitlamp.

Working controls have been grouped around the principal joy-stick control in order to permit one-handed manipulation with no more than flexion of the wrist. The other hand of the operator is left free to hold open the patients eye or move traverse the fixation device. This arrangement is particularly useful when applying gonioscopy or aplanation tonometry.

More, around the joy-stick, the base have been designed with great care so that a easy posing of the hand and a firm supporting of the wrist, together ensure very accurate movements. Addition magnification is available by movement of a lever, with more than momentary pause in observation. The microscope remains in focus throughout.

Concentric mounting of the lighting and microscope arms also ensures that both essentials remain in focus. Passing of the arms does not involve interruption of observation.

Since 1927 specialized experience in the design and production of ophthalmic instruments have impressed upon us the value of such attention to detail.

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CONTENTS

A

B

Figs. A and B (Okun). Gross and microscopic pathology in autopsy eyes: Part III. Retinal breaks without detachment.

Fig. A 59-E65A. (Same tear as in Fig. 1) Horseshoe tear photographed with slitbeam. Note pigmentary changes surrounding the tear.

Fig. B. 58-518L. (Same eye as in Fig. 2) Horseshoe tear with blood vessel bridging flap and tear.

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GROSS AND MICROSCOPIC PATHOLOGY IN AUTOPSY EYES*

PART III. RETINAL BREAKS WITHOUT DETACHMENT

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INTRODUCTION

The association of retinal holes with retinal detachment has been recognized since the earliest days of ophthalmoscopy by Coccius[1] (1853) and von Graefe[2] (1854). However, it was not until 1870 that de Wecker[6] first recognized a cause and effect relationship between the hole and the detachment. The importance of the vitreous in retinal detachment was suggested by Müller in 1858,[3] by Iwanoff in 1867,[4, 5] and by de Wecker in 1870.[6] In 1882, Leber[7] clearly defined the primary role played by vitreoretinal adhesions and vitreous detachment in the production of retinal tears. Subsequent studies by Nordenson,[8] Gonin,[9-14] and Lindner[15] further advanced our knowledge of the pathogenesis of retinal detachment, and paved the way for more logical approaches to therapy.

How and when a retinal break becomes converted into a retinal detachment has been the subject of much interest and speculation. Leber believed that contraction of preretinal bands produced the detachment while Lindner,[16] in 1933, theorized that motion of the eye was primarily responsible, and advocated putting the eye at rest as a prophylactic measure. Others have advocated diathermy around the tear as the most logical and effective prophylaxis.[17-25, 28-34] More recently the photocoagulator has been used to seal off retinal tears without detachment.[35-41] One need only to read the report of the 1958 International Congress of Ophthalmology symposium on the preventive therapy of idiopathic and secondary detachment[30] to realize that the problem of prophylaxis is not yet resolved.

It has long been known that not all retinal tears lead to detachment; however, the finding of a retinal tear without detachment has, in the past, been considered a rare enough finding to warrant its being reported in the literature.[42-54] An excellent clinical study and review of the literature on this subject was reported by Colyear and Pischel in 1956.[29] In this study and most others, the retinal tears seen clinically had been either those occurring in second eyes of retinal detachment cases or those which were symptomatic because of associated hemorrhages, floaters or lightning streaks. It remains for extensive clinical and pathologic surveys to discover the asymptomatic or latent retinal holes and thereby give a more true picture of the prevalence and natural history of the retinal hole. Previous pathologic studies of Hanssen,[55, 56] Teng and Katzin,[57-59] and Adams[79] have indicated that retinal breaks are more frequent than is generally realized. The present study substantiates this impression and gives further in-

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sight into the pathogenesis of the holes as well as the natural mechanisms which serve to protect the eye against detachment.

Method

Eyes were enucleated, refrigerated four to six hours after death, and fixed in 10-percent formalin either immediately after removal of a button for corneal transplantation, or after 24 to 72 hours of refrigeration. While still in formalin a superior meridional calotte was removed, and the entire circumference of the eye was examined with the biomicroscope as described in Part I.[60] Pictures were taken of the interesting lesions which were then sectioned for microscopic correlation.

Findings

In the present study of 494 consecutive eyes from 250 autopsies, histologically proven complete retinal breaks without detachment were found in 12 individuals, an incidence of 4.8 percent. Since all of these breaks were found in the 170 individuals over the age of 40 years, the incidence for this age group was seven percent. There were no histologically proven bilateral cases, although fellow eyes frequently showed either the early stages of hole formation or partial holes. Multiple holes were found in three eyes giving a total of 17 complete tears, 16 of which were serially sectioned for microscopic study. Nineteen additional individuals had lesions suspicious of hole formation but, on sectioning, these were found to be only partial tears, similar to changes found in other areas of those eyes which contained complete tears. The only retinal detachment in the present study was found in one eye of a diabetic individual with known diabetic retinopathy of long standing. In addition to the detachment, this eye contained retinitis proliferans, subretinal, retinal, preretinal and vitreous hemorrhages and diabetic type exudates. Because of the history and nature of the findings in this eye, it was not considered an idiopathic detachment.

The retinal breaks which were sectioned were of five types: flap tears, operculated holes, round holes with neither flaps nor opercula, areas of retinal degeneration with extreme thinning of the retina to the point of hole formation, and a small tear with a cellular flap.

1. Flap tears (eight cases)

In each of these eyes the vitreous was detached posteriorly and still attached to the anterior tip of the flap (figs. 1 to 4). In each case the internal limiting membrane was detached for a variable distance posterior to the tear, and glial cells appeared to be growing into the hyaloid at the point of vitreoretinal adhesion. Examination of these sections with the periodic acid-Schiff stain revealed that these cells were external to the internal limiting membrane and represented a portion of the superficial retina which had been detached posterior to the tear.

Four of the tears were across blood vessels which apparently remained intact at the time the retina tore (figs. 1 to 3, and color plate). Some retinal tissue remained around the vessel in two of the tears giving the appearance of two holes (figs. 1 and 3). The vessels usually crossed the break perpendicular to the meridional direction of the tear, but in one case the vessel bridged the flap in a meridional direction (color plate).

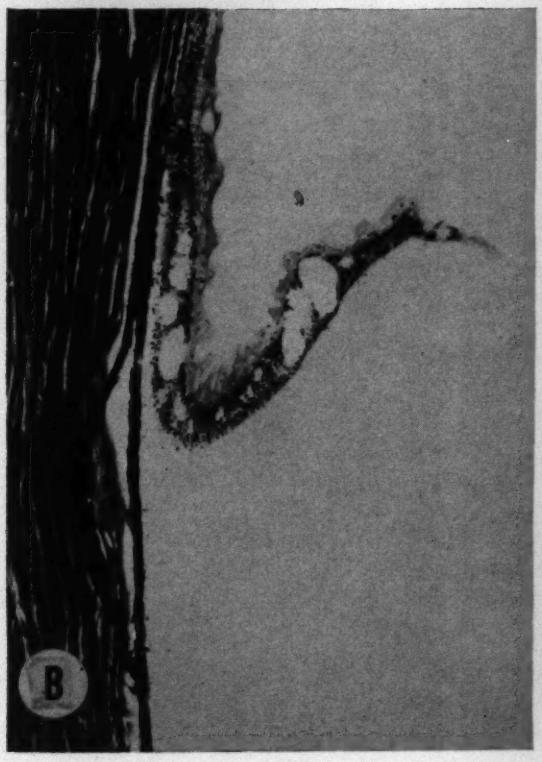
In seven of the eight flap tears there was a ring-shaped area of chorioretinal adhesion surrounding the tear (fig. 4 and color plate). Grossly, this appeared as either alternating patches of depigmentation and hyperpigmention, or entirely as a ring of hyperpigmentation (fig. 4).

Six of the flap tears were in the inferior one half of the globe and two in the superior one half. Seven were located in the equatorial region, while only one was located closer to the ora than the equator (table 2).

2. Round holes with opercula (two cases)

In both of these cases the operculum was still attached to the vitreous which was de-

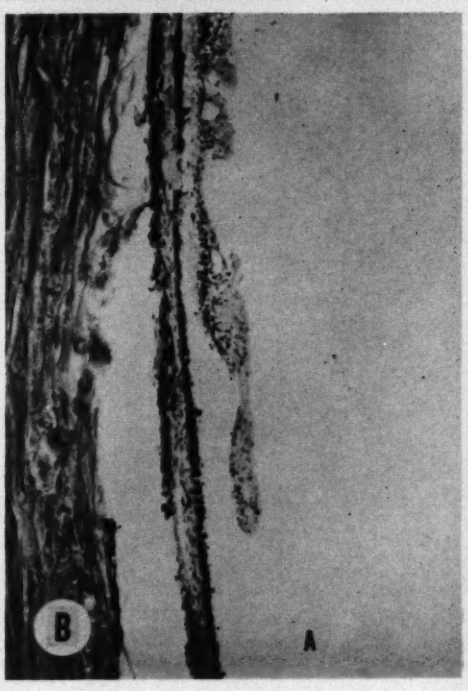
Fig. 1 (Okun). 59-E65A. (Same tear as Fig. A of color plate.) A 67-year-old white woman who died of metastatic liposarcoma. (A) Horseshoe tear (photographed by focusing Noyori slitbeam on vitreous), with posterior vitreous detachment, vitreoretinal adhesions at tip of flap and vascular bridge. (P) Postvitreous space. (B) Section through anterior flap shows vitreoretinal adhesions, cystoid degeneration in the flap and chorioretinal adhesions anterior to the flap. (Hematoxylin-eosin, reduced one third from ×80.) (C) Section through posterior edge of hole and vascular bridge shows posterior chorioretinal adhesions and inflammatory cells lined up on pigment epithelium. (Hematoxylin-eosin, reduced one third from ×80.)

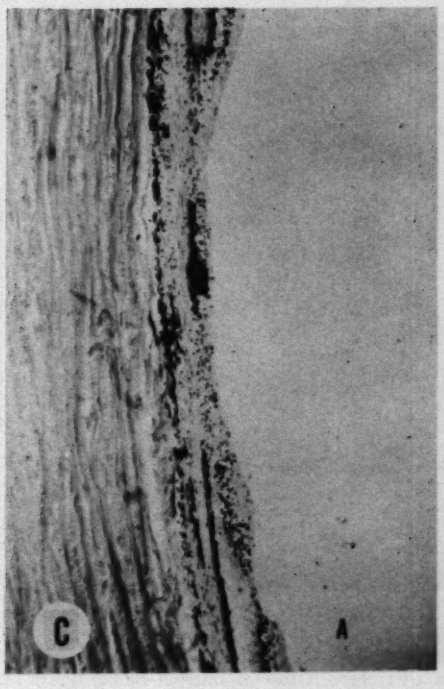


tached to a point anterior to the hole. (figs. 6 and 7). The operculum in each case was anterior to the hole, and in one, it contained some markedly thickened blood vessels (fig. 6). Both operculated holes were in the inferior one half of the globe in the region of the equator, and both were surrounded by chorioretinal adhesions. One of these holes

Fig. 2 (Okun). 59-518L. (Same eye as Fig. B of color plate.) A 65-year-old white man who died of postoperative bile peritonitis. (A) Horseshoe tear with vascular bridge (V) near the ora. (B) Section through tip of flap shows vitreoretinal adhesion (A), pigment epithelial cells which have migrated into the retina (P), degenerative and proliferative changes in the outer nuclear layer (E) and marked degeneration of the retinal tissue. (Hematoxylin-eosin, reduced one third from ×350.) (C) Section through posterior edge of tear and vascular bridge (V). Hematoxylin-eosin, reduced one third from ×200.)

Fig. 3 (Okun). 58-E655. A 72-year-old white man who died of epidermoid carcinoma originating in the pyriform sinus. (A) Operculum (O) to incomplete tear (I) in line with flap (F) to horseshoe tear (T) (photographed with Noyori slit-beam). (B) Section through posterior edge of tear shows marked irregularity in thickness of retina, probably produced at the time of vitreous detachment. (A) Anterior. (Van Gieson stain, reduced one third from ×80.) (C) Section through incomplete retinal tear shows chorioretinal scar with intraretinal pigment migration. (A) Anterior. (Van Gieson stain, reduced one third from ×80.)





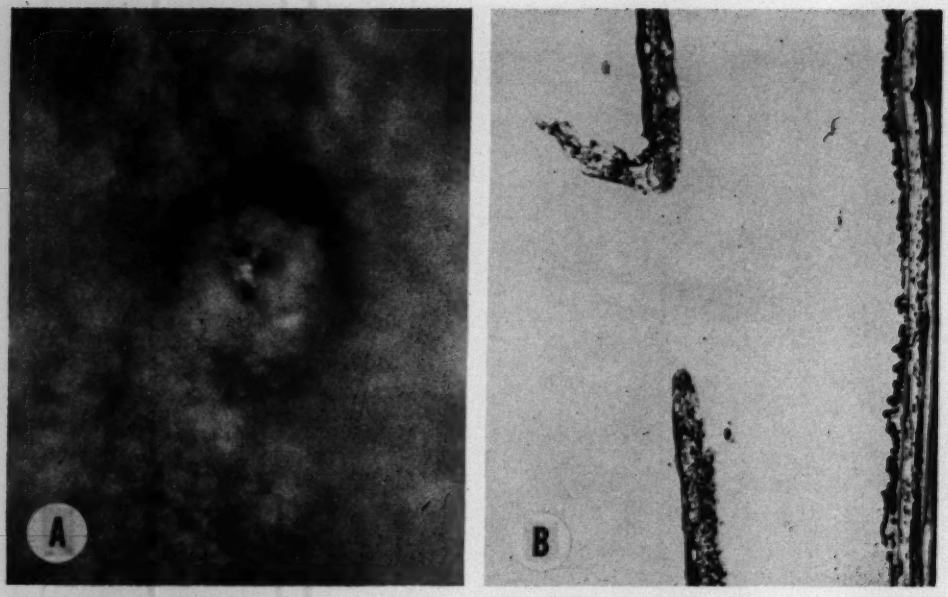


Fig. 4 (Okun). 58-E707. A 91-year-old white man who died of carcinoma of the liver. (A) Small flap tear completely surrounded by zone of hyperpigmentation. (B) Section through tear shows vitreous adhesion to flap, and hyperplasia of pigment epithelium with underlying drusenlike formations both anterior and posterior to the break. The retina is artefactitiously separated from the pigment epithelium. (Hematoxylin-eosin, reduced one third from ×125.)

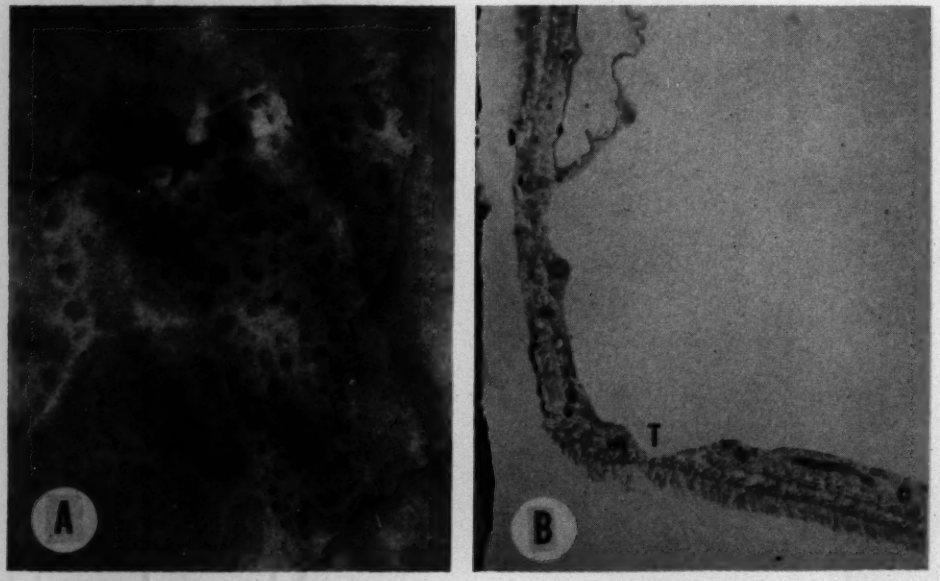
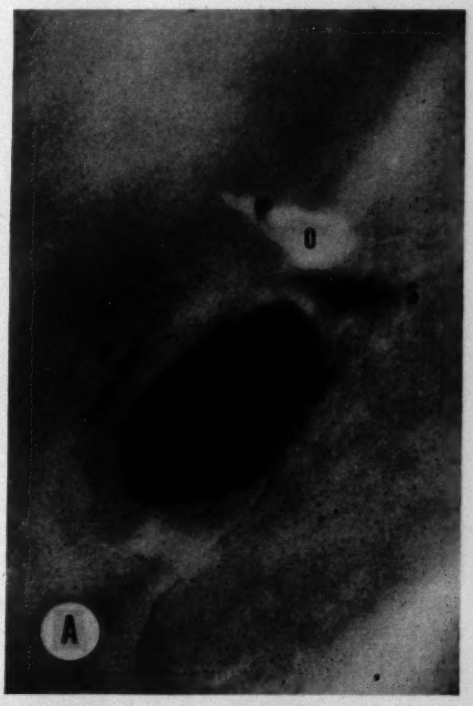
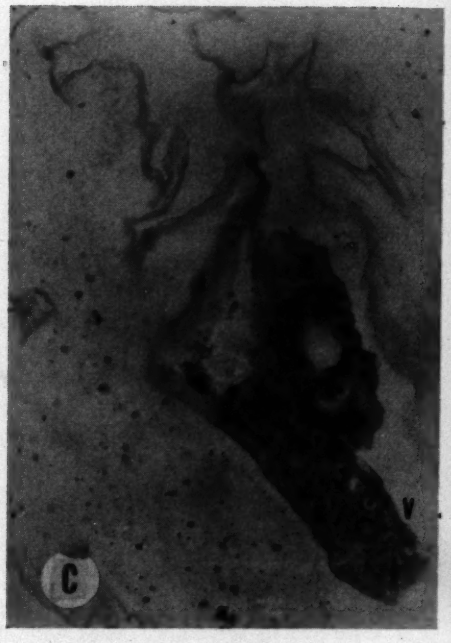


Fig. 5 (Okun). 58-489L. A 72-year-old Negress who died of adenocarcinoma of the pancreas. (A) "Motheaten" retina with areas of rarefaction running parallel to thickened or bloodless vessels. (B) Section shows posterior vitreous detachment which includes the internal limiting membrane. In thinned area (T) there is loss of internal retinal layers between two markedly thickened vessels (V). (PAS, reduced one third from ×115.)





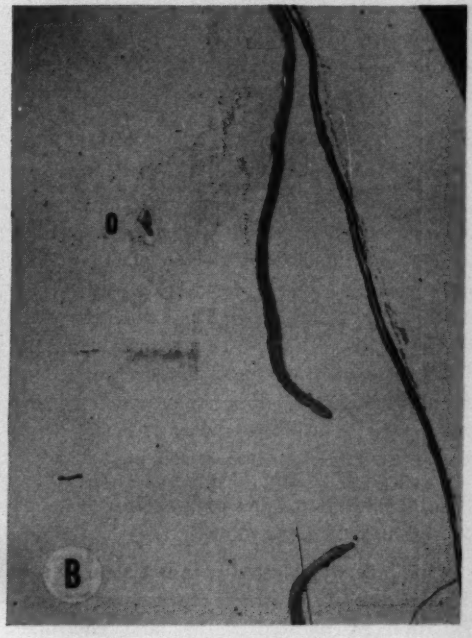


Fig. 6 (Okun). Same eye as Figure 5. (A) Operculated hole surrounded by pigmentation (P), with long axis parallel to blood vessel. Operculum (O) floating anterior to the hole casts a shadow on the retina. (B) Section shows vitreous detached to a point anterior to the hole and operculum (O) still attached to the vitreous. (PAS, reduced one third from ×30.) (C) High-power view of the operculum shows vitreoretinal adhesion and markedly thickened blood vessels (V) within the operculum. (PAS, reduced one third from ×300.)

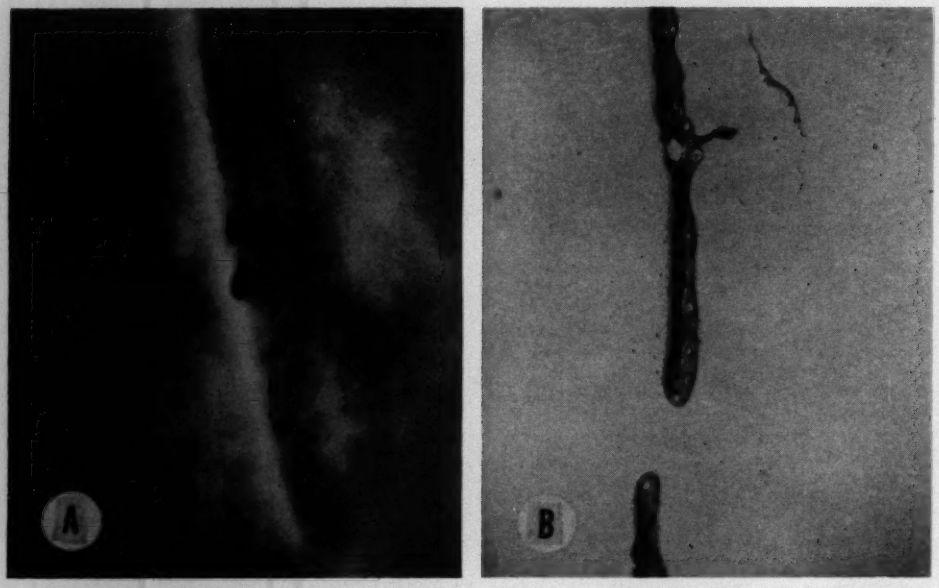


Fig. 7 (Okun). Same eye as in Figure 1. (A) Small round operculated hole surrounded by pigment ring. (Photographed with Noyori slitbeam.) (B) Section through hole shows posterior vitreous detachment to point anterior to the hole with production of partial thickness retinal flap at point of vitreoretinal adhesion. Operculum consists of single layer of elongated cells. (Hematoxylin eosin, reduced one third from ×85.)

occurred in an eye that had advanced degenerative changes (fig. 5), and another in an eye which had three additional flap tears.

3. Round holes without visible opercula (five cases)

Four of these holes were close to the ora and appeared to represent ruptured cystoid spaces associated with a disappearance of the outer retinal layers (figs. 8, 10, and 11). Each of these breaks had a small overlying area of vitreous liquefaction with evidence of local vitreous traction at the margins. The fifth round hole without operculum was in an area of marked vascular sclerosis with overlying vitreous liquefaction (fig. 12).

4. Hole within area of retinal degeneration (one case)

One hole was located within a zone of retinal degeneration, which represented a combination of marked retinal and choroidal atrophy, leading to extreme thinning of the retina and hole formation in several areas. There was vitreous liquefaction overlying the lesion and signs of local vitreous traction were present at the margins (fig. 13).

5. Small cellular flap tear (one case)

One eye contained a very small flap-type tear in which the flap consisted entirely of retinal elements (probably of glial origin) which had undergone proliferative and metaplastic change so as to resemble a foreign-body giant cell (fig. 17). These cells were not unlike those seen in the proliferating nonpigmented epithelium of the pars plana.

The dynamics of hole formation were also evident in many of the following types of incomplete retinal breaks:

1. Partial flap-tears with the vitreous attached to the tip of the flap, and a posterior vitreous detachment behind the flap (figs. 5 and 9).

2. Operculated incomplete holes with the operculum attached to the vitreous which is

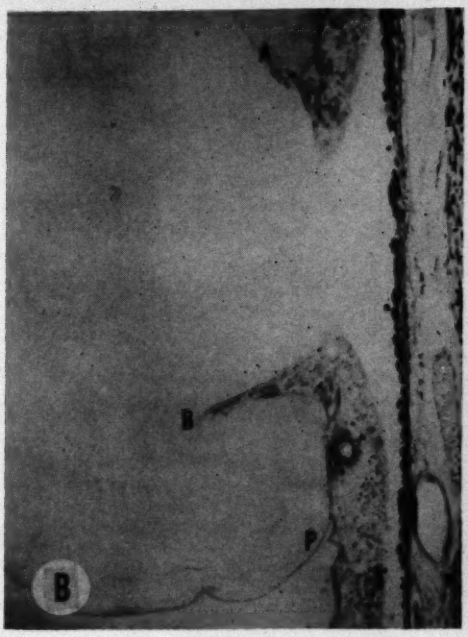


Fig. 8 (Okun). 58-E615. A 69-year-old white man who died of congestive heart failure. (A) Round hole adjacent to zone of cystoid degeneration close to the ora. (B) Section through hole shows posterior vitreous detachment up to point (P) just posterior to the hole. An area of local vitreous liquefaction overlies the hole and both anterior (A) and posterior (B) traction is present at the margins. (PAS, reduced one third from ×130.) (C) Adjacent section shows local vitreous traction and a markedly thickened retinal vessel. (PAS, reduced one third from ×130.)

detached to a point anterior to the partial hole (fig. 3).

3. Extremely thinned areas in the periphery with liquefaction of overlying vitreous, and vitreous traction at both anterior and posterior edges (ruptured cystoid spaces) (fig. 9).

4. "Motheaten" appearing areas of retina representing circumscribed loss of inner retinal layers occurring alongside markedly

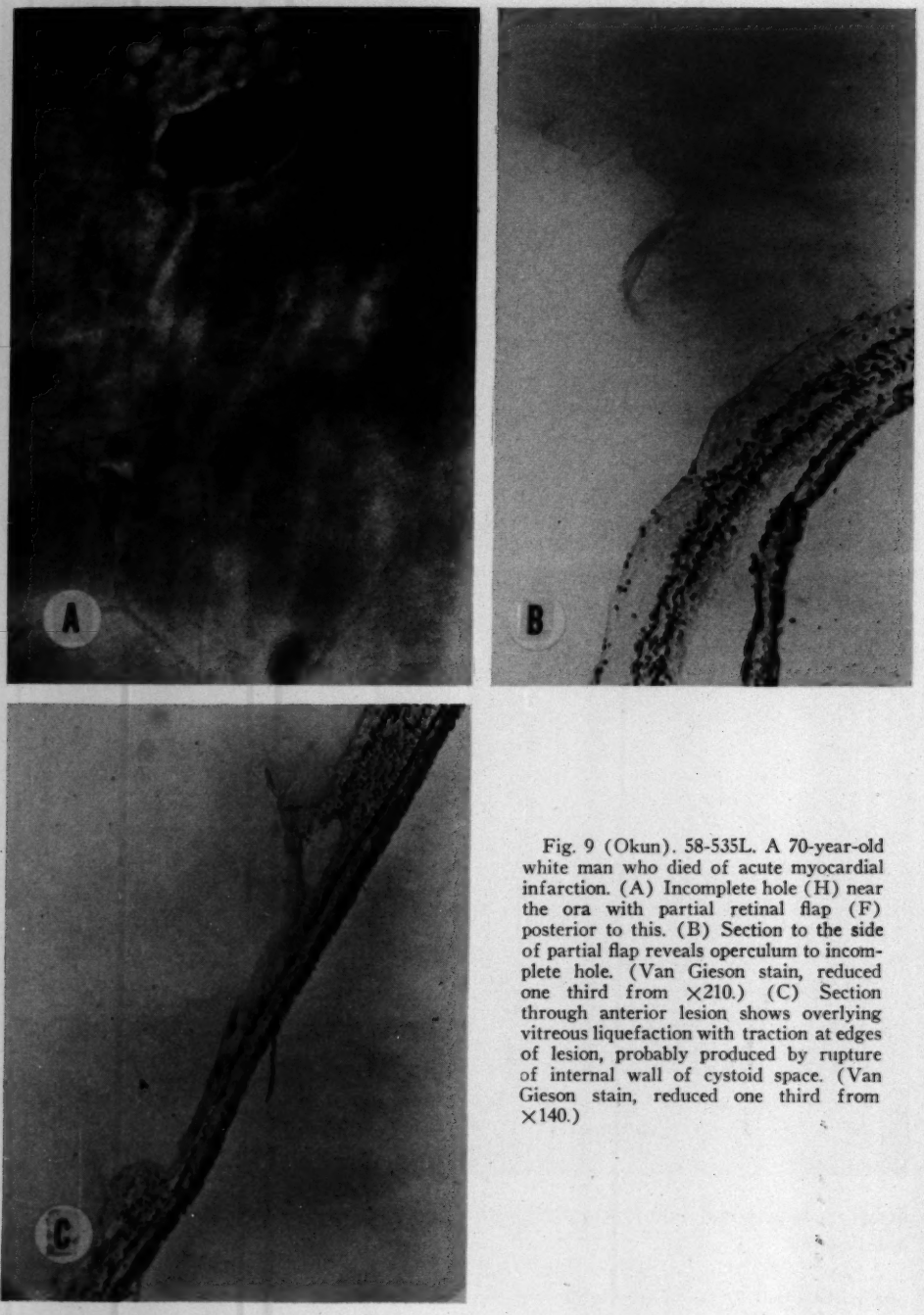


Fig. 9 (Okun). 58-535L. A 70-year-old white man who died of acute myocardial infarction. (A) Incomplete hole (H) near the ora with partial retinal flap (F) posterior to this. (B) Section to the side of partial flap reveals operculum to incomplete hole. (Van Gieson stain, reduced one third from ×210.) (C) Section through anterior lesion shows overlying vitreous liquefaction with traction at edges of lesion, probably produced by rupture of internal wall of cystoid space. (Van Gieson stain, reduced one third from ×140.)

Fig. 10 (Okun). 58-E567. A 62-year-old white woman who died of agranulocytosis and secondary infection. (A) Small hole (H) at the ora serrata (O). (B) Section through hole shows backward bending of pigment epithelium and anterior portion of Bruch's membrane with formation of reverse drusen near posterior edge of the hole.

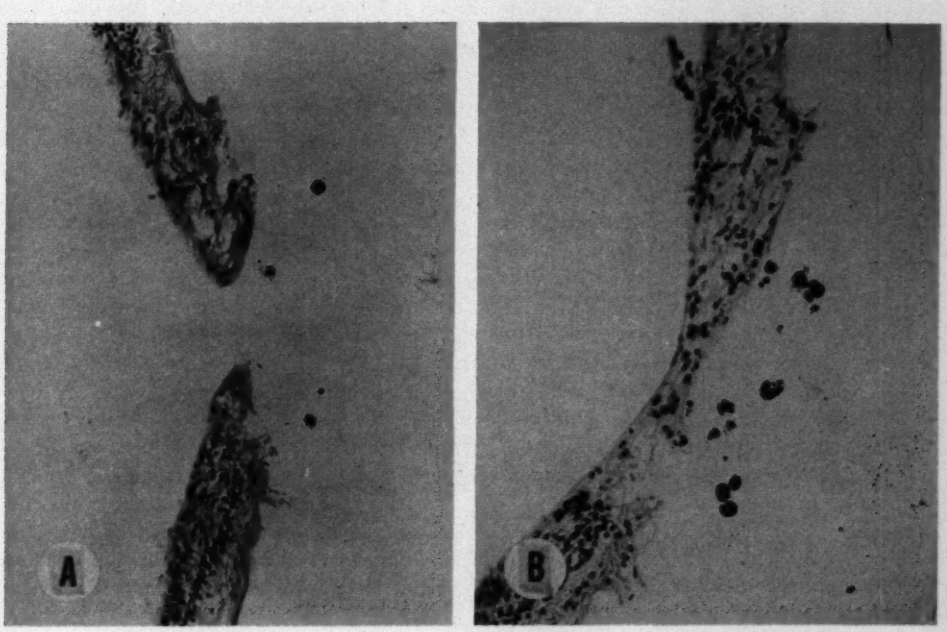


Fig. 11 (Okun). 59-E91. A 47-year-old white man who died of a brain tumor. (A) Round hole with overlying vitreous liquefaction and both anterior and posterior vitreous traction at edges of hole. Pigment laden cells are present in the subvitreal space. (Hematoxylin-eosin, reduced one third from ×150.) (B) Adjacent section. (Hematoxylin-eosin, reduced one third from ×200.)

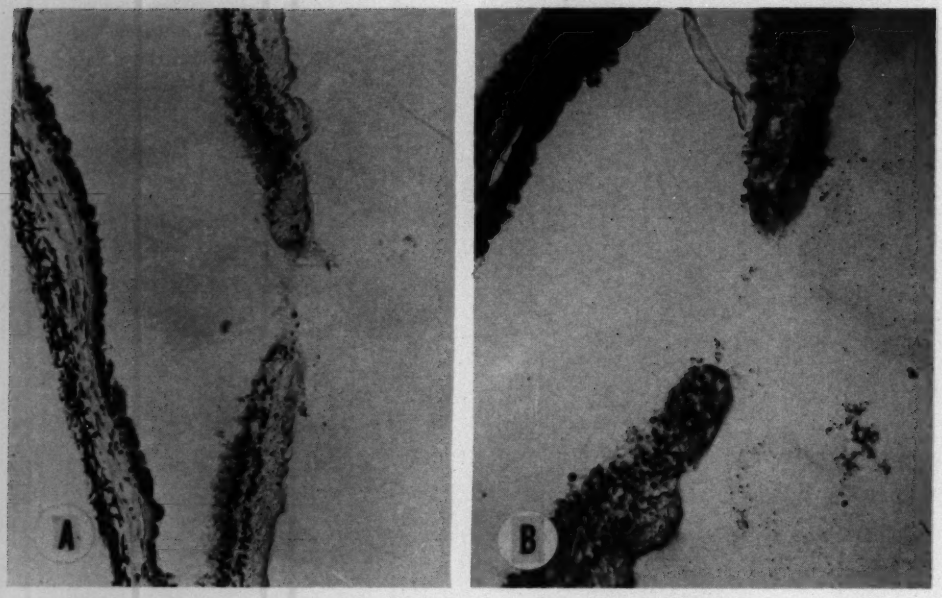


Fig. 12 (Okun). 59-E47. A 58-year-old white woman who died of a cerebral hemorrhage. (A) Section through round hole shows overlying vitreous liquefaction. (Van Gieson stain, reduced one third from ×143.) (B) Adjacent section shows overlying vitreous liquefaction plus thickened blood vessel near hole. (PAS, reduced one third from ×210.)

sclerotic retinal vessels with overlying posterior vitreous detachment (fig. 5).

5. Areas of marked retinal thinning, overlying vitreous liquefaction and replacement of part of the remaining retina by collagenous tissue, proliferating pigment epithelium, and drusenlike material in the region of a completely occluded vessel ("lattice degeneration") (figs. 14, 15, and 16).

6. Spherical aggregates of retinal cellular elements which appear pulled out of the retina by adherent vitreous strands, with areas of vascular sclerosis and pigmentary disturbance at their bases (fig. 18).

7. Retinal cysts, one of which contained four holes in its external wall.

Correlative studies

Although the number of patients with complete tears was too small for very significant correlative studies, these were undertaken to see if any trend could be detected.

The age of the individuals with tears varied from 44 to 91 at the time of death (table 1). The age of onset of the tear could not be accurately evaluated. Many of the tears, particularly in the older age groups, had moderate pigmentary reactions about them, indicating that they were not very recent. The age distribution was similar to that for retinal detachment, the incidence increasing with age.[26, 46]

The degree of atherosclerosis in these individuals was not significantly different from that of a matched series (matched for sex and age within two years*). It was of interest that each of the three patients who had a lattice type of peripheral degeneration had far advanced atherosclerosis.

Nine of the 12 individuals with complete retinal breaks had some degree of

* See previous publication for method of grading atherosclerosis and peripheral chorioretinal atrophy.[21]

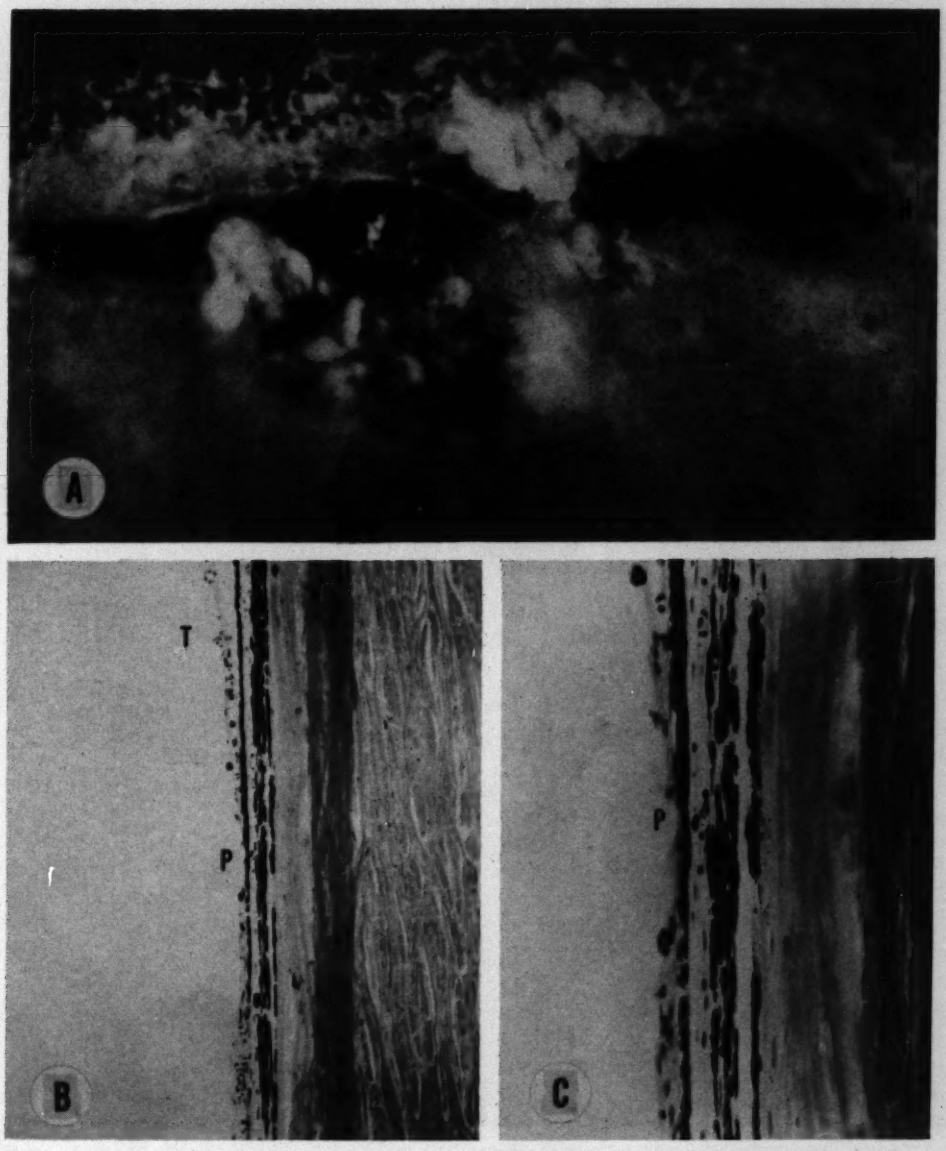


Fig. 13 (Okun). 59-E719. A 64-year-old white man who died of pulmonary carcinoma. (A) Peripheral chorioretinal atrophy with extreme retinal thinning to the point of hole formation in several small areas, including the far right (H). (B) Section through thinned retina showing vitreous traction (A). (Hematoxylin-eosin, reduced one third from ×110.) (C) High-power view of extreme retinal thinning to point of baring of pigment epithelium (P). (Hematoxylin-eosin, reduced one third from ×320.)

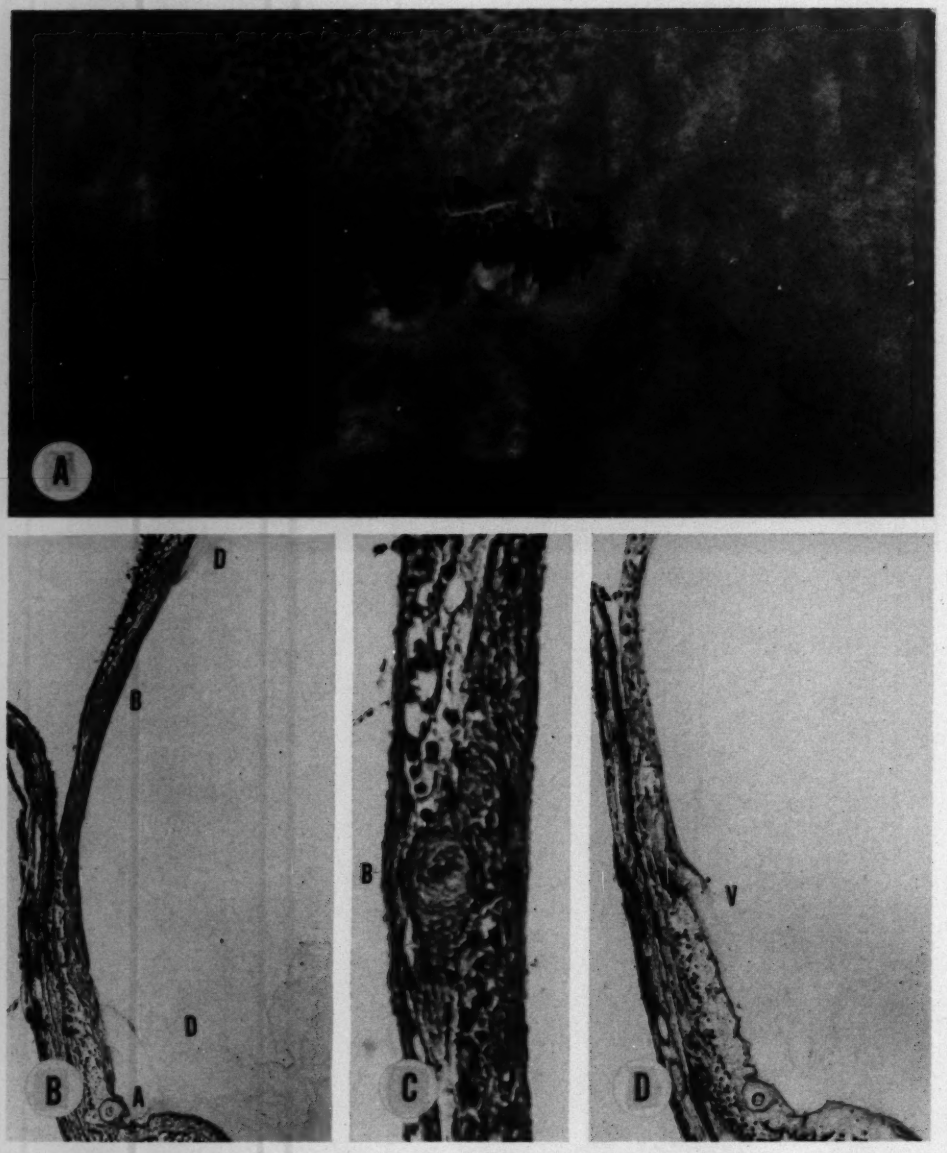


Fig. 14 (Okun). (Fellow eye of one in Figure 13.) (A) Lattice degeneration with chorioretinal atrophy and perivascular pigmentation (P). White appearing branches (A) and (B) can be traced centrally to patent retinal vessel. (B) Section through lesion shows area of chorioretinal atrophy (C), retinal thinning, overlying vitreous liquefaction (D), and markedly hyalinized vessels (A) and (B). (Van Gieson stain, reduced one third from ×125.) (C) High-power view of vessel (B) which is completely occluded. (Van Gieson strain, reduced one third from ×500.) (D) Section shows vitreous condensation on surface of thinned retina with overlying layer of cells of uncertain nature. (PAS-hematoxylin, reduced one third from ×185.)

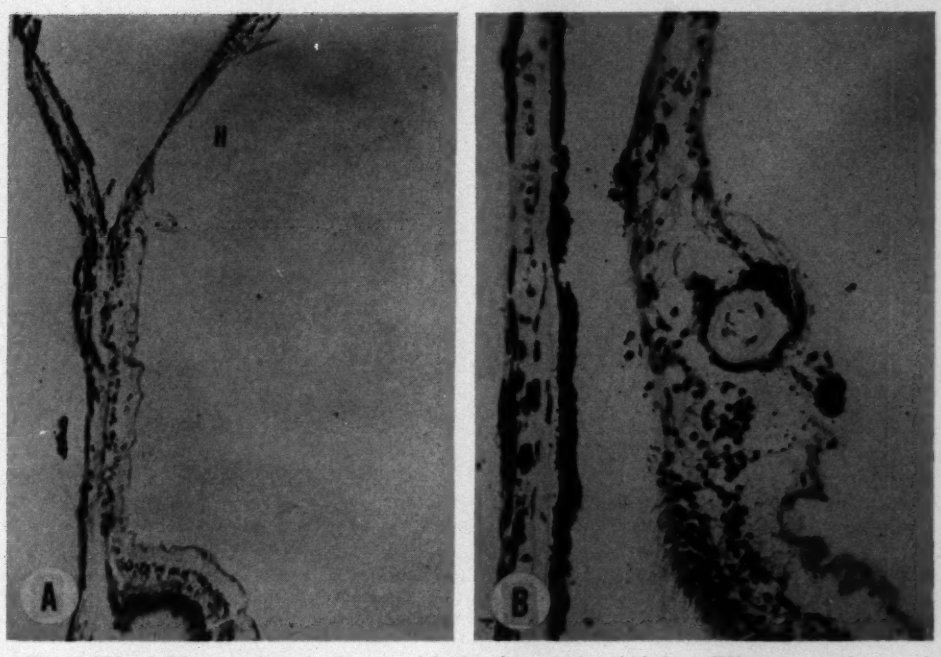


Fig. 15 (Okun). More sections from area of lattice degeneration. (A) Area (H) on gross photograph. Marked retinal thinning overlying area of vitreous liquefaction and traction both anterior and posterior to lesion. (Hematoxylin-eosin, reduced one third from ×125.) (B) Area (P) on gross photograph. Perivascular pigmentation at right side of the lesion. (Hematoxylin-eosin, reduced one third from ×300.)

peripheral chorioretinal atrophy, but only three had far advanced chorioretinal atrophy.*

Four of the 12 had pars plana cysts. However, this once again was not a significantly greater incidence than that of the matched control series.

The state of refraction of these eyes was not known; however, none of the eyes with retinal breaks had any of the changes associated with pathologic myopia. Two eyes on fixed section measured 26 mm. in anterior-posterior diameter, while all the others measured 25 mm. or less. It was, therefore, assumed that none of these eyes were severely myopic, although several may have been moderately so.

* See previous publication for method of grading atherosclerosis and peripheral chorioretinal atrophy.[61]

Comment

From the data accumulated in this study, it is apparent that, contrary to previous belief, only a small percentage of retinal breaks go on to detachment. In this study 12 individuals had retinal breaks which did not progress to clinical retinal detachment during their lifetime. In a survey by Böhringer on the incidence of retinal detachment in the canton of Zürich, he found 195 fresh idiopathic detachments in a relatively stable population from 1949-1955.[26] The age distribution of detachments in this population of 800,000[27] as well as the estimated total number of detachments in each 10-year age group is shown in Table 3. Also shown in this table is the relative prevalence of tears in the present autopsy population as compared to the estimated prevalence of retinal detachment in the Zürich population for each 10-

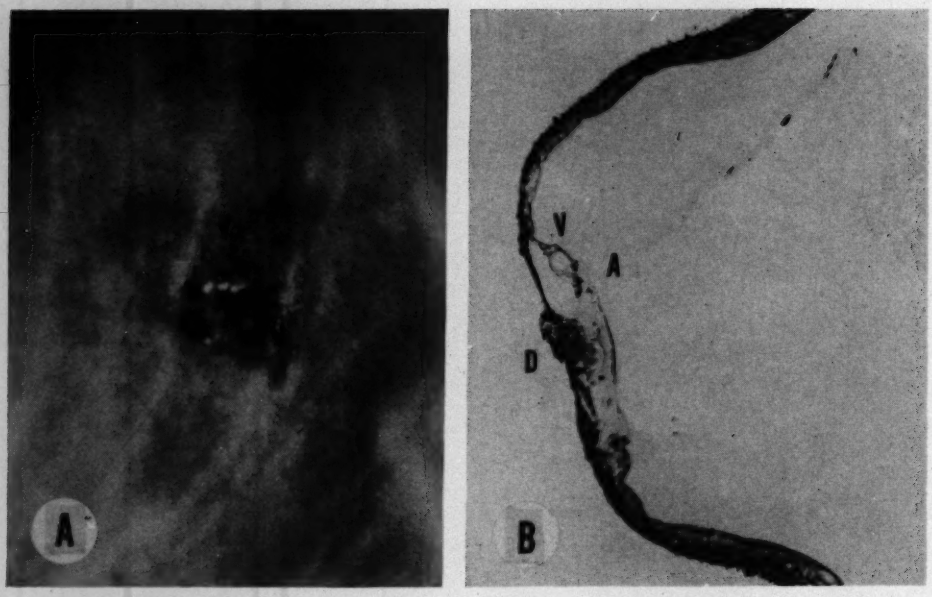


Fig. 16 (Okun). 58-E535. A 67-year-old white woman who died of cerebral thrombosis. (A) Area of retinal thinning crossed by whitish vessel (V) with four adjacent white spots. (B) Section shows vitreo-retinal adhesion (A) about hyalinized blood vessel (V), local vitreous liquefaction, marked atrophy of the retina with vitreous condensate, and drusenlike material accounting for most of the retinal thickness. (Hematoxylin-eosin, reduced one third from ×110.)

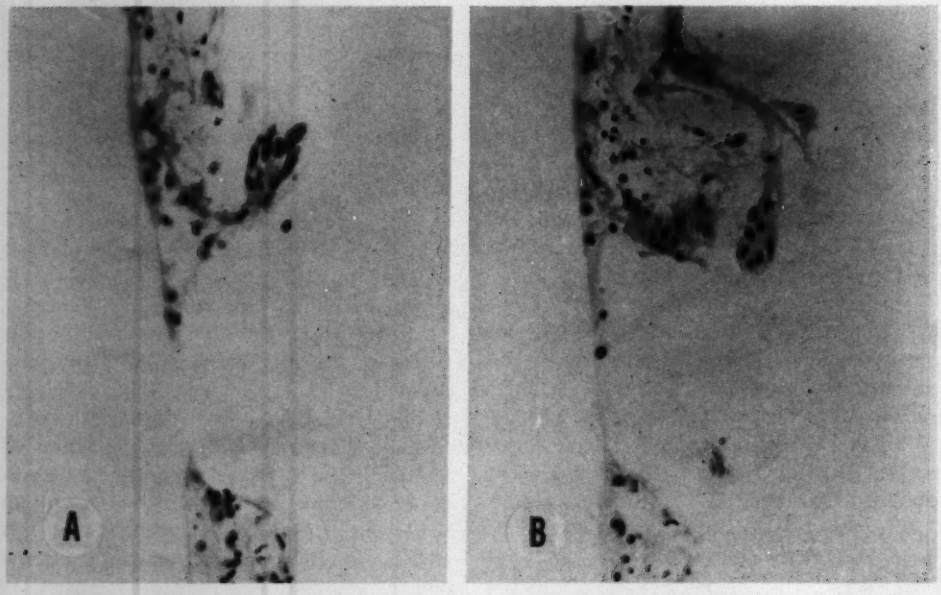


Fig. 17 (Okun). 59-E62. A 44-year-old Negro who died of metastatic adenocarcinoma of the colon. (A) Microscopic section of tear shows a flap which consists of an accumulation of retinal elements which have undergone metaplastic change as to resemble a foreign body giant cell. There is a posterior vitreous detachment (best seen in PAS sections). (Hematoxylin-eosin, reduced one third from ×300.) (B) Adjacent section showing groups of similar cells. (Hematoxylin-eosin, reduced one third from ×300.)

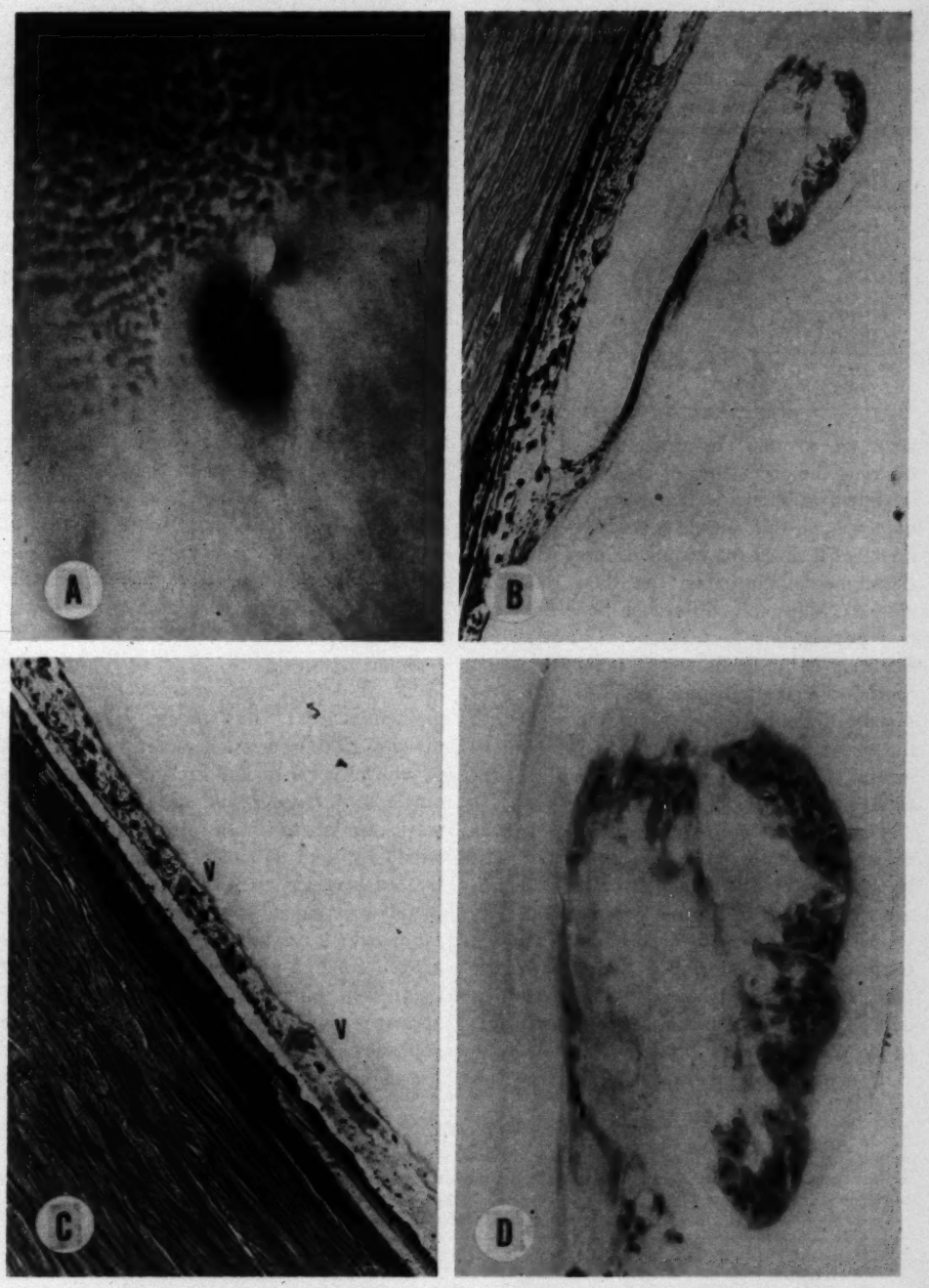


Fig. 18 (Okun). 58-E662. A 53-year-old Negress who died of pulmonary embolism and myocardial infarction. (A) Pedunculated ball of tissue in the process of separation from the retina. (B) Section shows adherent vitreous bands incorporated into a cellular mass derived from retinal elements which have undergone proliferative and metaplastic change. (Van Gieson stain, reduced one third from ×185.)

(C) Base of lesion shows increased thickness of blood vessels, marked intraretinal pigmentary migration and moderate thinning of the retina. (PAS and hematoxylin, reduced one third from ×185.) (D) High-power view of spherical tissue. (Van Gieson stain, reduced one third from ×320.)

TABLE 1

AGE PREVALENCE OF RETINAL TEARS

Age (yr.)	No. of Autopsies	No. of Individuals with Breaks	%
0– 1	42	0	0
1–20	20	0	0
20–40	18	0	0
40–50	26	2	8
50–60	40	1	3
60–70	51	5	10
>70	53	4	7
TOTAL	250	12	5
>40	170	12	7

year age group. The method used for estimating the prevalence of retinal detachment is shown in Table 4. The overall prevalence of tears in this autopsy study is approximately 70 times the estimated prevalence of detachments (utilizing the data of Böhringer). The main difference between these two populations is that one is dead while the other is living. However, unless the same factors which predispose to death, also predispose to retinal breaks, it would seem that the great majority of tears do not lead to retinal detachment in the course of a lifetime.

This indirect approach to the problem of the retinal tear without detachment will best be resolved by following retinal tears which are discovered on routine examination. The report of Colyear and Pischel[29] is an attempt to resolve the problem of the symptomatic tear. It is believed by many that the incidence of retinal detachment in second eyes of detachment cases is high enough to warrant prophylactic therapy.[30–41, 62] However, the ultimate fate of the asymptomatic or latent retinal hole appears to be one of self-healing.

The next question to be answered is the reason these tears have not gone on to detachment. As was pointed out by Lindner[15] and Schepens,[63] all flap tears must lead to some degree of detachment the moment the tear occurs, but this may be very minimal. Ring-shaped areas of chorioretinal adhesions were present about most of the flap tears in this series, thus preventing any further detachment. These areas of pigmentary disturbance were much too round and regular to be pre-existent chorioretinal scars, and were more likely the result of the irritation produced by continuous vitreous traction at the site of the flap. In several sections inflammatory cells could be seen lined up on the pigment epithelium near the base of the tear (fig. 1).

Some of the tears were surrounded by areas of depigmentation as well as hyperpigmented areas. The depigmented areas were the sites of most firm chorioretinal adhesions in which the choroid and retina appeared as a single unit (figs. 1 and 2). These findings were similar to those reported by Wadsworth[64, 65] and Klien[66] in tears previously treated by surgery. Other tears were completely surrounded by a ring of hyperpigmentation which on sectioning represented a localized zone of proliferation of the pigment epithelium (fig. 4). This proliferative response is most likely associated with a greater cohesiveness between retinal receptors and the pigment epithelium. This study confirms

TABLE 2

HOLE TYPE AND LOCATION

Type	Superior Temporal	Superior Nasal	Inferior Temporal	Inferior Nasal	Equator	Ora	Total
Flap tear	2		2	4	7	1	8
Operculated				2	2		2
Round w/o operculum	3		1	1	1	4	5
Within area degen.				1		1	1
Cellular flap	1				1		1
TOTAL	6		3	8	11	6	17

TABLE 3

RELATIVE PREVALENCE OF HOLES AND DETACHMENTS (UTILIZING DATA OF BÖHRINGER)

Age	Total Population	No. of Fresh Detachments 10 Yr.	10-Year Incidence Rate	Estimated Total No. of Detachments in Each 10 Yr. Group (Prevalence)†	% Detachment in Zurich Population	% Holes in Present Autopsy Population	Ratio Hole: Detachment
0– 9	100,000*						
10–19	87,687	7	0.00008	7	0.01	0	
20–29	125,116	11	0.00009	21	0.02	0	
30–39	113,105	10	0.00009	29	0.03	0	
40–49	126,969	41	0.00032	74	0.06	8	133:1
50–59	98,284	47	0.00048	104	0.11	3	27:1
60–69	64,426	59	0.00092	127	0.20	10	50:1
70–79	36,445	18	0.00049	90	0.25	7	28:1
>80	40,000*	2	0.00005	101	0.25		
TOTAL	800,000	195		553	0.07	5	70:1
>40	366,124	167		496	0.14	7	50:1

* Estimate.
† See Table 4 for method of estimating prevalence.

the belief that pigmentary changes about retinal holes are a favorable sign.[14, 15, 33, 52, 67, 68]

It is well known that most of the tears accompanying retinal detachment are located superiorly.[46, 69] The majority of the tears in this study were located inferiorly. This lends support to the belief that inferior tears are less dangerous than those occurring superiorly.[29, 67]

The operculated round hole is produced by

TABLE 4

ESTIMATED PREVALENCE OF RETINAL DETACHMENT FROM INCIDENCE DATA

Present Age (yr.)	Number of Cases of Retinal Detachment by Age of Exposure to Risk								Total Cases (Prevalence)
	0– 9 10–19	10–19 20–29	20–29 30–39	30–39 40–49	40–49 50–59	50–59 60–69	60–69 70–79	70–79 >80	
>80	3.2	3.6	3.6	12.8	19.2	36.8	19.6	2.0	101
70–79	2.9	3.3	3.3	11.7	17.5	33.5	18.0		90
60–69	5.2	5.8	5.8	20.6	30.9	59.0			127
50–59	7.9	8.8	8.8	31.5	47.0				104
40–49	10.2	11.4	11.4	41.0					74
30–39	9.0	10.2	10.0						29
20–29	10.0	11.0							21
10–19	7.0								7
TOTAL									553

Note: Estimates are shown to one decimal and are rounded only after accumulating for each line.

Assumptions Using This Method

1. Assume a stable population. Therefore the incidence rate applies to a cohort of persons passing through a 10-year age bracket in a period of 10 years. Thus, the rate for 20–29 means the incidence in a group *now* 10–19 as they become 20–29.
2. Assume the stated population, for computing rates, is the average in that age bracket. Thus the rate in the age bracket 20–29 is $\frac{11}{125,116} = 0.00009$. As a cohort passes through this age bracket, they will develop retinal detachments at the rate of 0.00009 per person.
3. Next, assume the population now represents achieved age, thus the persons now 20–29 have passed through the 10–19 and 0–19 age brackets. While passing through, they experienced the rate for that age bracket. Mortality is not a factor as we are dealing only with survivors.

the same mechanism as the flap tear. The only difference is that continued traction tears the flap free at its base. Posterior vitreous detachment and vitreoretinal adhesions play the same important role in the pathogenesis of this type of hole. Once the flap is detached there is no further traction in the vicinity of the hole, thus making this a potentially less dangerous hole. At the same time, the probability of hemorrhage with this type of hole seems greater because the added tear at the base allows more vessels to be injured (fig. 6).

The pathogenesis of the small round holes near the ora is less well understood than that of the flap tears. Many of these breaks appear to be ruptured cystoid spaces with associated defect in the outer wall. Overlying vitreous liquefaction and local vitreous traction signs at their edges suggest a primary vitreous change. However, it has yet to be shown that these vitreous changes are present prior to the rupture of the inner wall of the cystoid space. Increased pressure within the cyst itself has been proposed as a mechanism of rupture.[71] Since these holes are situated close to the site of insertion of the posterior zonular fibers, changes in zonular tension have also been considered a possible etiologic factor.[58, 70] Because of their peripheral position, these breaks are usually anterior to the zone of posterior vitreous detachment, and therefore are not exposed to the large mass of fluid whose momentum continually threatens the flap tear. However, there is a small overlying zone of vitreous liquefaction with a tendency for further tearing to occur at the margins (figs. 8, 9, and 11).

Lattice degeneration is a fairly common type of peripheral degeneration associated with retinal holes and detachment. It is so named because of the resemblance of the white lines to a white lattice-work. Previous illustrations of this type of change appear in the works of Gonin,[14] Vogt,[75] Arruga,[46] Schepens,[63, 72] and Pau.[73] In histologic studies of these areas, Pau described thickened blood vessels crossing through the lesions, but believes that the dendritic figures represent strongly hyalinized and fibrosed strands of new-formed perivascular connective tissue and modified pigment epithelium. In the present histologic study, the main white horizontal line represents a completely occluded vessel, probably a venule. The other white lines which make up the remainder of the lattice appear to be branches of this occluded vessel; but this cannot be proved with certainty in the histologic sections. In addition to the occluded vessels, these areas of degeneration are characterized by (1) a proliferation of pigment epithelium and a laying down of drusenlike material within the retina, (2) liquefaction of the overlying vitreous with a condensation of the most peripheral part upon the inner layers of the much thinned retina, (3) a layer of cells of uncertain nature overlying the condensed vitreous layer. (These cells may be derived from either retinal elements or the cortical cells of the vitreous.)

Until it is known which occurs first, the vascular or the vitreous change, the pathogenesis of this type of lesion will remain a matter of conjecture.

The exact nature of the small globular masses found on or near the inner surface of the retina is not known. The cells which make up these spheres appear to be of glial origin. The associated finding of pigmentary disturbance and marked vascular sclerosis at their base indicates an inflammatory or degenerative etiology.

Such spheres have previously been reported by Gonin,[13] Samuels,[76] Hagedoorn and Siegar,[77] Teng and Katzin[57, 59] and Manschot.[78] Teng and Katzin feel that these represent congenital rests because of their similarity to findings in babies' eyes which contained no signs of inflammatory disease. Hagedoorn and Siegar have described similar preretinal findings in a case of infantile retinal detachment, and Manschot in cases of persistent primary vitreous.

Whatever the etiology of these cells may

be, it is generally agreed that they are the site of firm vitreoretinal adhesions. When vitreous detachment is added to the condition, partial or complete retinal tears may form. It is quite possible that such vitreoretinal adhesions may initiate larger flap tears; however, in the present study such cells were present in only one flap tear, and in this case it made up the entire flap. It is more likely that the usual fate of these cellular aggregates is complete separation from the retina with the formation of globular floaters, and a residual small round hole in the case of the full-thickness flap.

Summary

1. Histologically proven retinal breaks without detachment were present in 12 of 250 autopsies studied, a prevalence rate of 4.8 percent (seven percent in those over the age of 40 years).

2. The pathology and possible pathogenesis of five types of retinal breaks are presented: flap tears, operculated holes, nonoperculated round holes, atrophic holes in areas of degeneration, and small holes with cellular flaps.

3. The histopathology of lattice degeneration is presented.

4. The reasons these breaks did not lead to detachment are discussed.

5. One may conclude from this study that only a small percentage of retinal breaks go on to clinical detachment.

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COLISTIN TREATMENT OF EXPERIMENTALLY PRODUCED PSEUDOMONAS CORNEAL INFECTION*

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Corneal infections caused by the gram-negative coliform group, particularly Pseudomonas aeruginosa, are generally rapidly progressive, severe, and result in considerable, if not total, destruction of the eye. Attempts to control these infections by the use of antibiotics have not been uniformly successful. Reports[1-5] have indicated that polymyxin B is one of the most effective agents in the control of these infections.

A new antibiotic, colistin, claimed to be effective against many gram-negative organisms and for which systemic therapeutic levels have been found to be without significant toxicity or side-effects, seemed worthy of evaluation. Colistin was isolated in 1950 by Koyama et al.[6] Resistance studies indicate that there is no cross resistance with the usual broad spectrum antibiotics and that resistance is not readily developed by sensitive organisms.[7-9]

Since colistin in therapeutic dosages (2.0 to 4.0 mg./kg. daily) is of low toxicity for man and, following intramuscular administration, effective blood levels remain for eight to 12 hours,[9] this study was undertaken to evaluate colistin in the control of experimentally produced Pseudomonas corneal infections in the rabbit. Two routes were assayed—systemic and topical.

METHOD

The strain of organisms used was Pseudomonas aeruginosa recently isolated from a

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TABLE 1

TREATMENT OF RABBITS

Group	No. Rabbits	Dosage of Colistin
I	6	Intramuscularly 2.5 mg./kg. One injection two hr. prior to challenge
II	8	Intramuscularly 2.5 mg./kg. every 12 hr. beginning 24 hr. after challenge, for five days
III	6	Normal controls, no treatment

patient with a corneal infection. The organism was found to be sensitive to a 10 μg. per ml. concentration of colistin as determined by the tube dilution method. In all experiments an 18-hour broth culture was used to infect the rabbits' corneas. The rabbit's eye after anesthetization was prepared by cutting through the corneal epithelium and into the stroma with a 0.2-mm. deep, 5.0-mm. diameter trephine in the central portion of the cornea. Two drops of the 18-hour culture were dropped into the eye, as in previous experiments.[1, 10, 11]

In the first experiment, normal rabbits of approximately five pounds were divided into three groups and treated as outlined in Table 1.

RESULTS

All three groups of rabbits appeared essentially the same when examined daily for five days during treatment. There was very little difference between the treated and the control animals in that all groups showed progressive involvement of the cornea with dense white necrosis centrally and diffuse clouding peripherally. Since the organisms had been shown to be sensitive to less than 10 μg. of colistin per ml. in vitro and since the intramuscular dose given was calculated to exceed this level in the serum, it was thought that the drug was not reaching the corneal tissues in a sufficiently high concentration to be effective when given by the intramuscular route.

Experiment 2 was therefore designed to evaluate topical and subconjunctival administration. Additional groups of rabbits were infected as previously and treated as outlined in Table 2.

The results are summarized in Table 3. At 24 hours after challenge, a difference was already detectable between the eyes of the Group I rabbits, which had been receiving treatment since two hours postchallenge, and those of the other groups, which had as yet received no treatment. The main differences were the lesser circumlimbal injection, the lesser exudate, and the clearer area within the limits of the trephine incision in the treated rabbits.

After 24 to 48 hours of the subconjunctival injections, the superior bulbar conjunctiva became moderately injected and slightly edematous but no severe local reaction to the colistin was noted. After 48 hours of treatment, Group I rabbits had, without exception, eyes that were white except superiorly where the subconjunctival injections were being given. Ten of the 12 corneas were clear, with only two of the 12 having any corneal haze and, in both eyes, it was confined to the area within the trephine incision.

In Group II, where treatment beginning

TABLE 2

EVALUATION TOPICAL AND SUBCONJUNCTIVAL ADMINISTRATION

Group	No. Rabbits	Treatment
I	6	Treatment begun two hr. after challenge with colistin eyedrops (10 μg./ml.) in each eye every four hr. and 1.0 mg. subconjunctivally in each eye every eight hr., for five days.
II	6	Treatment begun 24 hr. after challenge with colistin eyedrops (10 μg./ml.) in each eye every four hr. and 1.0 mg. subconjunctivally in each eye every eight hr., for five days.
III	6	Treatment begun 24 hr. after challenge with colistin eyedrops (10 μg./ml.) in each eye every four hr., for five days.
IV	4	Normal controls, no treatment.

TABLE 3

RESULTS OF TREATMENT WITH COLISTIN

Group	No. of Eyes	Treatment	Residua of Infection		
			Minimal	Moderate	Severe
I	12	Begun two hr. postchallenge, subconj. inj. q8h, drops q4h	10	2	0
II	12	Begun 24 hr. postchallenge, subconj. inj. q8h, drops q4h	3	6	3
III	12	Begun 24 hr. postchallenge, drops q4h	1	2	9
IV	8	Controls, no treatment	0	2	6

24 hours after challenge consisted of subconjunctival colistin injections every eight hours in addition to drops every four hours, the results after 48 hours of treatment showed a slightly better over-all response when compared to the controls, although a few individual eyes were as bad as the controls. The peripheral cornea outside the trephine incision was less edematous and opaque; there was less circumlimbal and conjunctival injection and less exudate was present than in the controls.

The Group III rabbits, treated with colistin eyedrops alone every four hours beginning 24 hours after challenge, showed no improvement over the controls. The control rabbits had the typical progressive involvement which ultimately ended in complete opacity of the cornea.

Despite the excellent therapeutic record being acquired by colistin against gram-negative organisms at other body sites,[12,13] our studies show that it has definite limitations when used in the treatment of corneal infection. It apparently was not able to enter the cornea in sufficient quantity when given intramuscularly, either pre- or postinfection. The topical treatment alone, applied every four hours was of no apparent benefit when begun 24 hours postchallenge.

When used both topically and subconjunctivally, a significant degree of improvement was evident. However, the response to colistin was not markedly better than that observed to polymyxin B in previous experiments.[1] It certainly appears from the results obtained when treatment was begun two hours, as compared with 24 hours after challenge, that promptness in the initiation of treatment is of paramount importance.

It is felt that colistin has sufficient efficacy to warrant its use in the treatment of Pseudomonas corneal infections. In view of the ineffectiveness of this drug when given by the intramuscular route with regard to corneal infection due to Pseudomonas I feel that subconjunctival injection is indicated in addition to topical application at frequent intervals.

SUMMARY

Colistin,* an antibiotic with specific activity against gram-negative bacteria, has been experimentally evaluated in the treatment of corneal infection due to Pseudomonas aeruginosa. Under the conditions of this experiment, colistin did not control the experimental infection when applied topically or when given intramuscularly. Simultaneous topical and subconjunctival administration of colistin gave demonstrable protection against Pseudomonas infection in rabbit corneas. The duration of time between challenge and initiation of therapy was an important factor in the control of the infection.

Johns Hopkins Hospital (5).

* Colistin in this study was supplied by Warner-Lambert Research Institute, Morris Plains, New Jersey.

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HISTOPATHOLOGIC DIFFERENTIATION OF GRANULAR, MACULAR AND LATTICE DYSTROPHIES OF THE CORNEA*

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The clinical differentiation between granular, macular and lattice dystrophies was first clearly made by Bücklers.[1] Franceschetti and Babel[2,3] later demonstrated that these dystrophies could be distinguished from one another histopathologically. Two years ago we[4] presented additional histologic methods of distinguishing macular from lattice dystrophy. Since then, we have had an opportunity to examine not only a larger number of cases of macular and lattice dystrophy but also cases of granular dystrophy. As a result of our study of these cases, we have found simple histologic methods which permit easier and more convincing differentiation of these three dystrophies than those used by other workers.

We have had available for histologic examination portions of the cornea removed from 24 patients who, on the basis of the clinical appearance of their corneas, had either granular, macular or lattice dystrophy. Six of the 24 patients had granular dystrophy, 11 had macular dystrophy, and seven had lattice dystrophy. Two of the lattice dystrophy cases involved known blood relatives. All of the other patients were from different families.†

The corneal tissue used in our study was obtained in the course of operations on the

* From the University of Illinois, College of Medicine, Department of Ophthalmology, Chicago, and the Armed Forces Institute of Pathology, Washington, D.C. Most of the cases on which this study is based have been added to the collection of the Registry of Ophthalmic Pathology, Armed Forces Institute of Pathology, and all the photomicrographs were made at the Armed Forces Institute of Pathology.

† It was not possible to obtain pedigrees extending over four or five generations in any of these cases and the possibility that some of the patients were distant relatives cannot be excluded.

TABLE 1

HISTOPATHOLOGIC FEATURES OF THE DIAGNOSTIC STROMAL LESIONS OF GRANULAR, MACULAR AND LATTICE DYSTROPHIES

	Granular (Groenouw I) (Bücklers I)	Macular (Groenouw II) (Bücklers II)	Lattice (Biber-Haab-Dimmer) (Bücklers III)
Microscopic morphology of lesions in formalin-fixed tissue	Hyaline, granulated*	Nonhyaline, granulated*	Hyaline, fibrillar
Birefringence of lesions	Not birefringent, or less birefringent than the surrounding stroma	Not birefringent, or less birefringent than the surrounding stroma	Usually more birefringent than the surrounding stroma
Staining characteristics of lesions:			
Hematoxylin-eosin[5]	Pink to red	Pale gray	Pink
Masson's trichrome[5]	Red	Faint blue	Red to purple
Periodic acid—Schiff[5]	Faint magenta	Dark magenta	Usually dark magenta
Alcian blue[5–7]	Pink†	Blue	Pink†
Colloidal iron[5,8,9]	Yellow‡	Blue	Yellow‡
Weigert's resorcin—Fuchsin[5]	Yellow‡	Purple	Yellow‡

* The stromal lesions of both granular and macular dystrophy appear to be composed of granules when the tissue has been fixed in formalin. The adjective "granulated" is used to describe these lesions rather than the word "granular" in order to avoid confusion with "granular dystrophy."

† Pink color from nuclear fast red counterstain.

‡ Yellow color from picric acid staining in van Gieson counterstain.

cornea—penetrating keratoplasty in almost all cases. The specimens were fixed in formalin and embedded in paraffin. Sections were cut perpendicular to the epithelial surface. A variety of routine and special staining methods was employed and those found most useful are listed in Table 1.

HISTOPATHOLOGIC OBSERVATIONS

EPITHELIUM AND BOWMAN'S MEMBRANE

Nonspecific alterations in the epithelium and in Bowman's membrane were observed frequently in all three types of dystrophy. Variations in thickness of the epithelium, disturbances of the normal orderly arrangement of cells, and abnormalities of the individual cells (intracellular edema, pyknotic nuclei, etc.) were noted in all three types of dystrophy (figs. 1, 2, and 3). Eosinophilic subepithelial plaques were present in most of the cases of macular dystrophy and lattice dystrophy but were not observed in the cases of granular dystrophy. Frequently the material in these plaques or in portions of them had staining characteristics similar to the basement membrane of the epithelium.

Thickening of Bowman's membrane, as well as fibrillation and dehiscences in the membrane, were noted in all three dystrophies. Although Bowman's membrane often was fragmented or absent in some areas, portions of this membrane could be demonstrated in sections from all 24 cases.

In lattice dystrophy the alterations in the superficial cornea—variations in thickness of the epithelium, eosinophilic subepithelial plaques, fragmentation and dehiscences in Bowman's membrane—were often so striking that attention was sometimes diverted from the less conspicuous, but diagnostically more important lesions in the stroma. There did not seem to be any feature of these superficial alterations that was especially characteristic of or specific for any one of the dystrophies.

In all three types of dystrophy, lesions in the superficial stroma—lesions of diagnostic significance (see later)—sometimes came into direct contact with the epithelium in places where Bowman's membrane was ab-

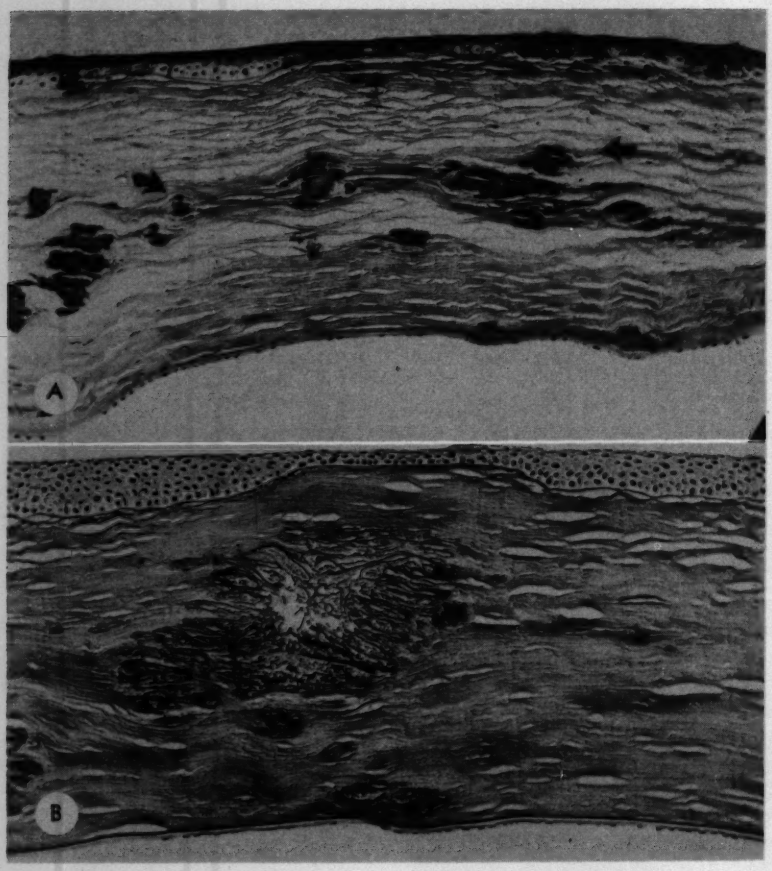


Fig. 1 (Jones and Zimmerman). Nonspecific superficial changes in granular dystrophy. There are irregular areas of thickening and atrophy of the edematous epithelium, and Bowman's membrane is largely destroyed. Arrows indicate some of the typical stromal lesions. (A) Masson's trichrome stain, ×100, AFIP Acc. 907066. (B) Wilder's reticulum stain, ×115, AFIP Acc. 847576.

sent (figs. 4, 5, and 6). In macular dystrophy, superficial stromal accumulations of finely granulated* material sometimes extended through a relatively small gap in Bowman's membrane and then spread out between that membrane and the epithelium. When sections were cut through the peripheral portion of such a lesion, the granulated material appeared to be separated from the stroma by Bowman's membrane, but examination of serial sections revealed the granulated material to be continuous through a gap in Bowman's membrane with a superficial stromal lesion.

In macular dystrophy, the epithelium sometimes contained small discrete particles or grains with the same staining reactions as the amorphous granulated material found in the stroma (see later).

* The word "granulated" as used in this paper is intended to mean essentially the same thing as "granular," that is, consisting of or containing grains or granules. In describing the stromal lesions of macular dystrophy, the word "granulated" is used instead of "granular" to avoid confusion with "granular dystrophy."

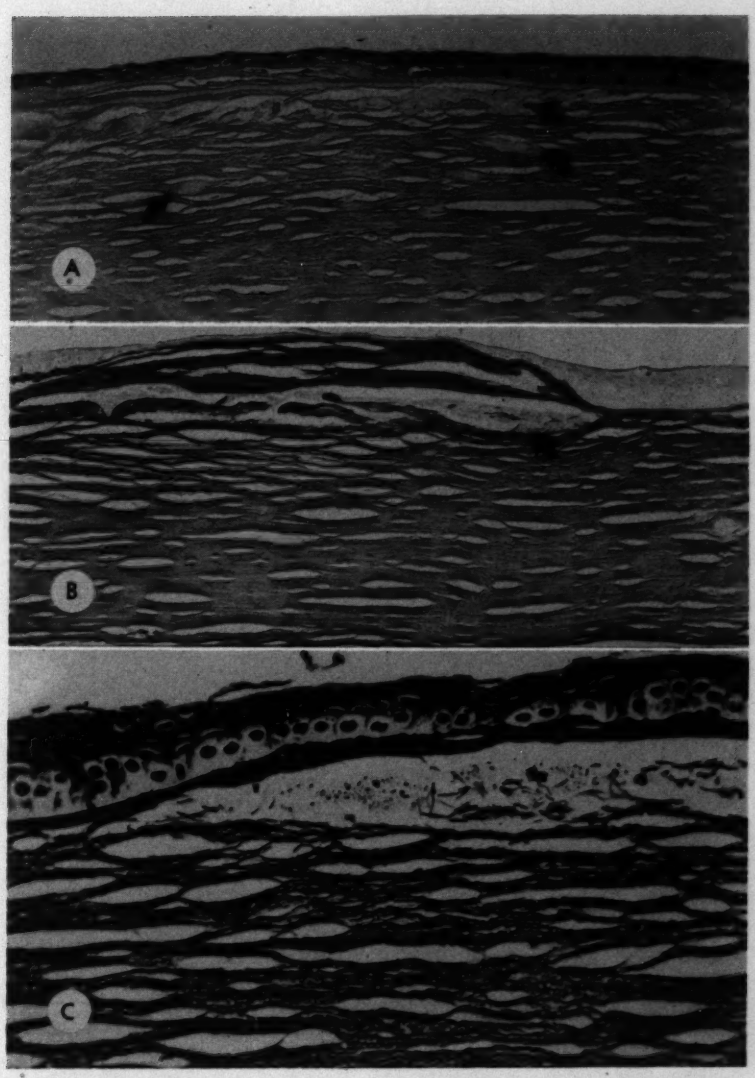


Fig. 2 (Jones and Zimmerman). Nonspecific superficial changes in macular dystrophy. The degenerated epithelium exhibits areas of extreme thinning. There is great thickening of the basement membrane, and large hyaline plaques are present between the epithelium and Bowman's membrane. Arrows indicate some of the specific stromal lesions. (A) Masson's trichrome stain, ×115, AFIP Acc. 840032. (B) Colloidal iron method for acid mucopolysaccharides (AMP), ×115, AFIP Acc. 840032. (C) Wilder's reticulum stain, ×305, AFIP Acc. 840032.

Stroma

There were lesions of diagnostic significance in the corneal stroma in all of the 24 cases included in this study. For each of the three dystrophies, there were distinctive stromal lesions which were found only in that dystrophy and not in the other two. The histopathologic characteristics of these dis-

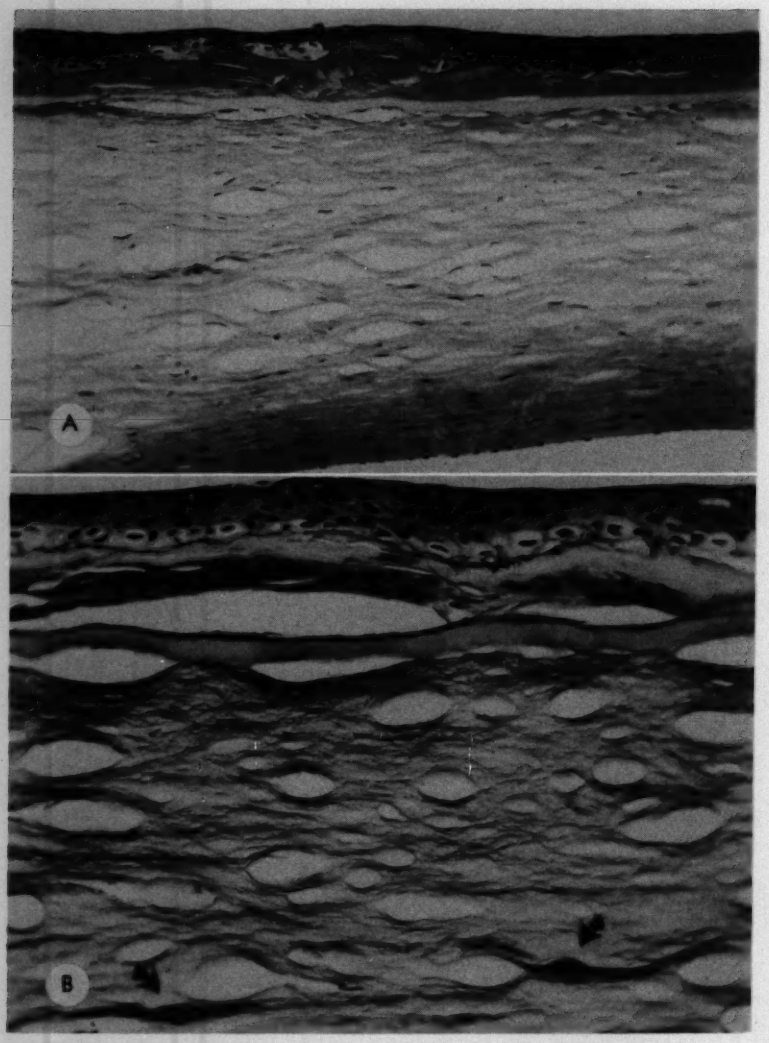
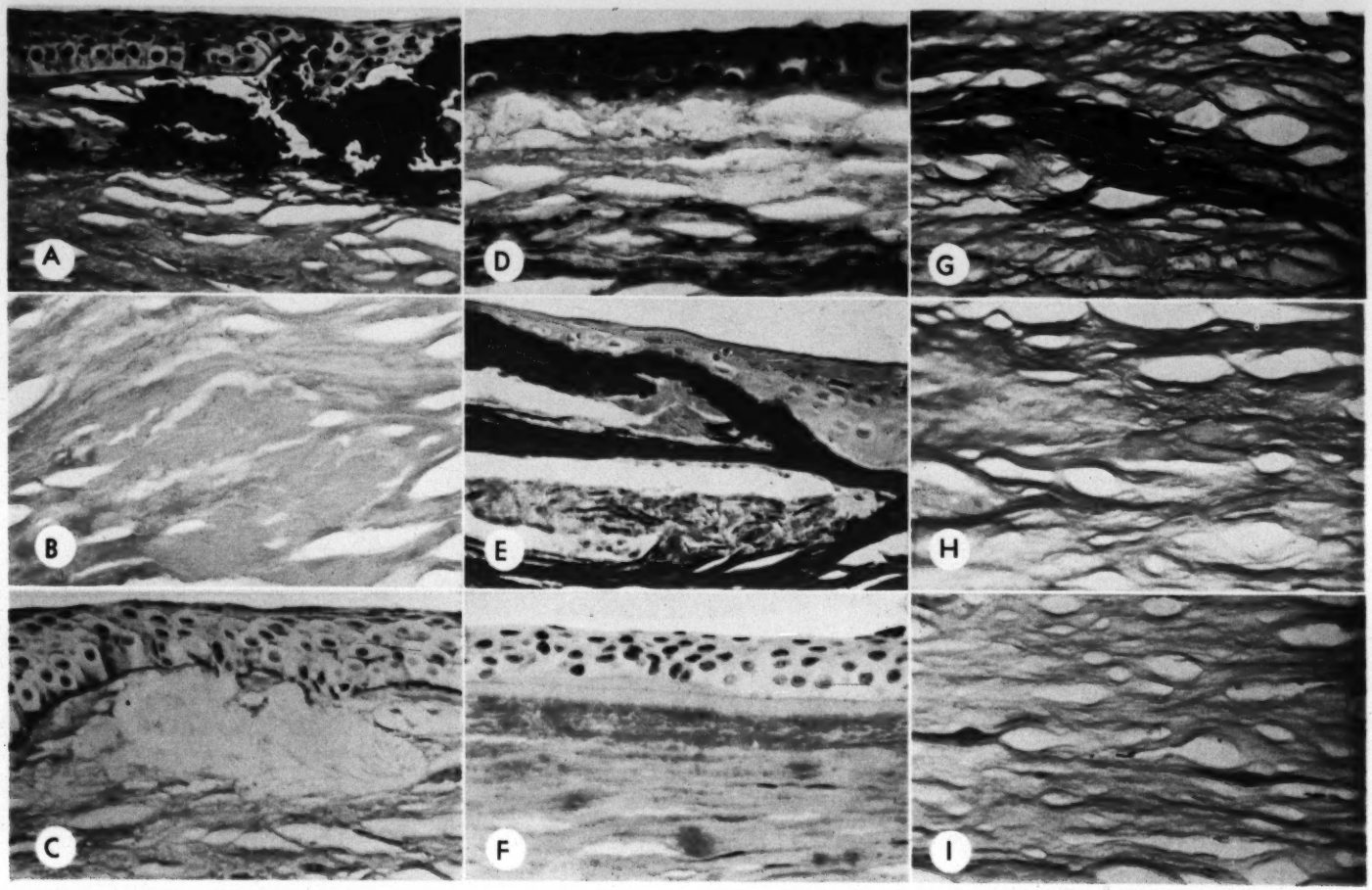


Fig. 3 (Jones and Zimmerman). Nonspecific superficial changes in lattice dystrophy. The markedly degenerated epithelium is extremely irregular and separated from Bowman's membrane by a thick plaque of hyalin. Arrows indicate specific stromal lesions which may be few and inconspicuous in comparison with the nonspecific alterations in and beneath the epithelium. (A) Hematoxylin-eosin, ×150, AFIP Acc. 220210. (B) Periodic acid-Schiff reaction (PAS), ×305, AFIP Acc. 220210.

Plate 1 (Jones and Zimmerman). Histopathologic differentiation of granular, macular and lattice dystrophies of the cornea.

Differential staining characteristics of granular (A, B, and C), macular (D, E, and F), and lattice dystrophies (G, H, and I) observed in paraffin sections: The sections shown in the top row (A, D, and G) have been stained with Masson's trichrome, those in the middle row (B, E, and H) have been prepared by the colloidal iron method for acid mucopolysaccharides and counterstained with van Gieson's solution, while those in the bottom row (C, F, and I) have been subjected to the periodic acid-Schiff reaction. The Masson stain and colloidal iron reaction serve to differentiate macular dystrophy from granular and lattice dystrophies, while the periodic acid-Schiff reaction is helpful in separating granular dystrophy from macular and lattice dystrophies. (A, B, and C: AFIP Acc. 929101, ×265, D and F: AFIP Acc. 847253, ×325, E: AFIP Acc. 840032, ×325, G, H, and I: AFIP Acc. 220210, ×220.)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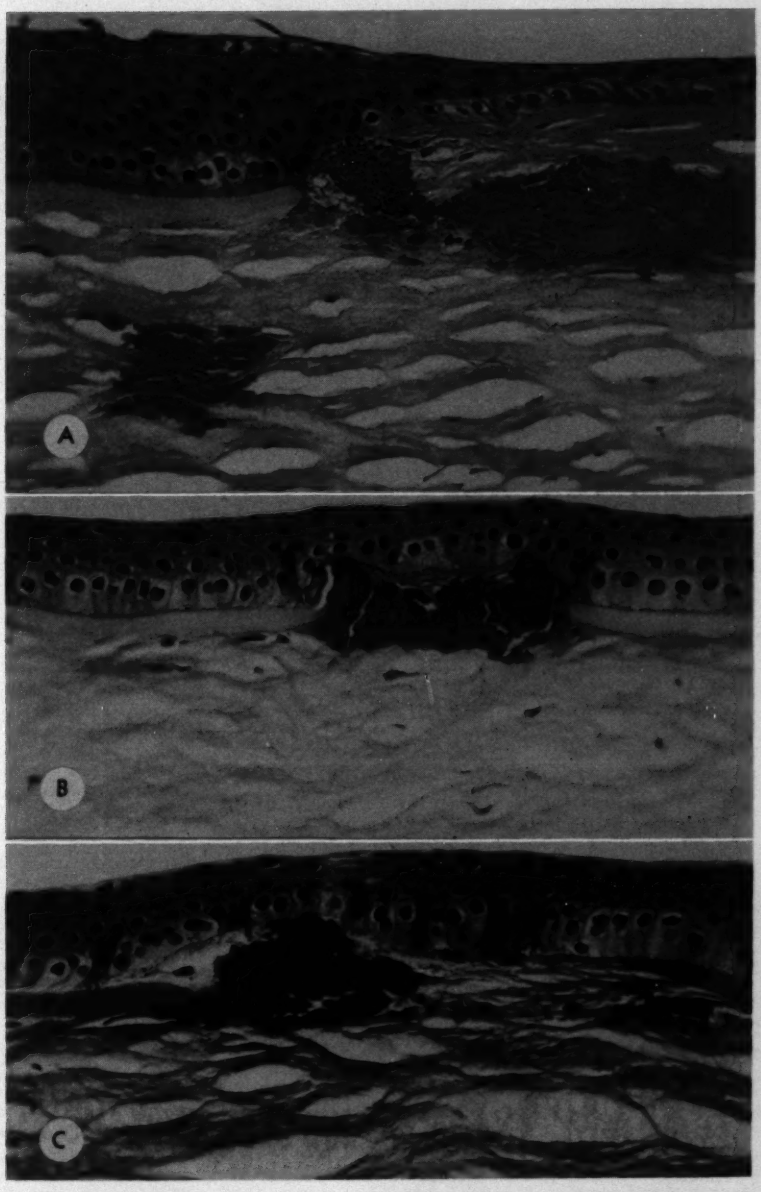

Fig. 4 (Jones and Zimmerman). Specific stromal lesions of granular dystrophy extending through interruptions in Bowman's membrane to gain subepithelial position. (A) Hematoxylin-eosin, ×305, AFIP Acc. 929101. (B) Hematoxylin-eosin, ×305, AFIP Acc. 955120. (C) Masson's trichrome, ×305, AFIP Acc. 955120.

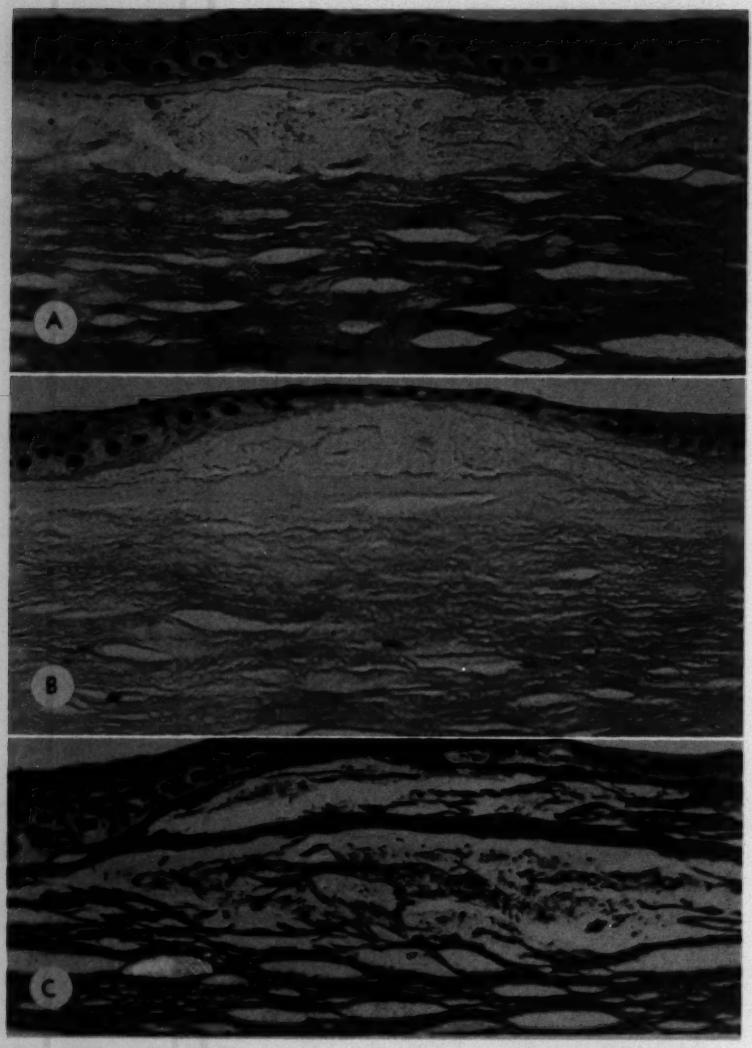

Fig. 5 (Jones and Zimmerman). Specific stromal lesions of macular dystrophy extending through gaps in Bowman's membrane and spreading between that membrane and the epithelium. (A and B) Hematoxylin-eosin, ×300, AFIP Acc. 847253. (C) Wilder's stain reveals irregular thickening of the basement membrane and many argyrophilic fibers associated with the diagnostic lesion lying superficial and deep to Bowman's membrane, ×305, AFIP Acc. 840032.

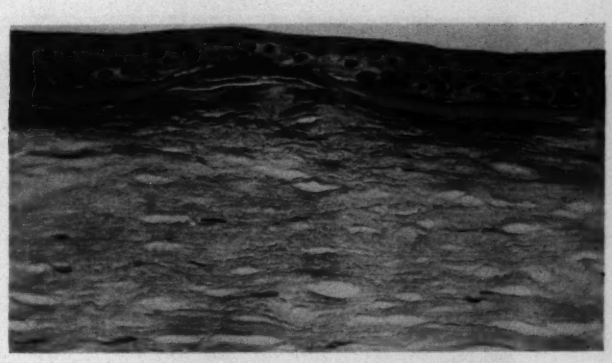

Fig. 6 (Jones and Zimmerman). Superficial stromal lesion of lattice dystrophy extending through a dehiscence in Bowman's membrane to come into contact with the epithelium. Hematoxylin-eosin, ×305, AFIP Acc. 847258.

tinctive stromal lesions are compared and contrasted in Table 1.

The stromal lesions typical of macular dystrophy were of three types: (1) "early" lesions—small focal areas of swelling within lamellae (intralamellar lesions) (figs. 2-A, 5-A, 7-A, and 7-B); (2) large accumulations of an amorphous granulated substance in areas where the lamellae were destroyed*; and (3) small focal interlamellar deposits of amorphous granulated material (fig. 7-A lower arrow, and fig. 7-C). These lesions have been described in detail in a previous publication.[4] The characteristics of the large accumulations of amorphous granulated substance are summarized in Table 1. The small interlamellar deposits showed the same staining reactions as the large accumulations. The fact that much of this material took an intense blue stain with alcian blue[5-7] and with colloidal iron methods (modified Hale procedures[5,8,9]) strongly suggests that it is composed, at least in part, of an acid mucopolysaccharide.†,‡ There was no decrease in the staining intensity when the tissue was treated with hyaluronidase or diastase prior to staining.

The stromal lesions characteristic of macular dystrophy were entirely different from those seen in granular and lattice dystrophy (color plate). As indicated in Table 1, the stromal lesions in the cases of granular dystrophy had tinctorial characteristics very similar to those seen in lattice dystrophy except with the periodic acid-Schiff (PAS) reaction. In the PAS preparations (color plate) the characteristic stromal lesion of granular dystrophy was faint magenta (less intensely stained than the surrounding stroma), while the lesion of lattice dystrophy was usually dark magenta (more intensely stained than the surrounding stroma).§

When examined with polarized light, the lesion typical of granular dystrophy was less birefringent than the surrounding corneal stroma (fig. 8). In each of the cases of lattice dystrophy, the majority of the typical stromal lesions were more birefringent than the surrounding stroma (fig. 10).

To differentiate granular from lattice dys-

* The destruction of stromal lamellae is particularly well illustrated in the Wilder reticulum stain (fig. 2-C). The amorphous granulated substance is shown in fig. 5-A and in the color plate.

† Bolla and Rovescalli[10] believe that the granulated material in macular dystrophy is a neutral mucopolysaccharide because, in their case, this material stained positively with the PAS reaction and with mucicarmine, but did not show metachromasia with thionine.

‡ We have had available for study three corneal biopsies from cases of Hurler's syndrome. In these corneas there were accumulations of amorphous material staining positively with alcian blue and with colloidal iron methods. The deposits seen in the cases of Hurler's syndrome were principally small interlamellar accumulations. The small intralamellar lesions and the large degenerative lesions characteristic of macular dystrophy were not seen.

§ In one of the seven cases of lattice dystrophy the majority of the stromal lesions stained less intensely than the surrounding stroma in the PAS preparation.

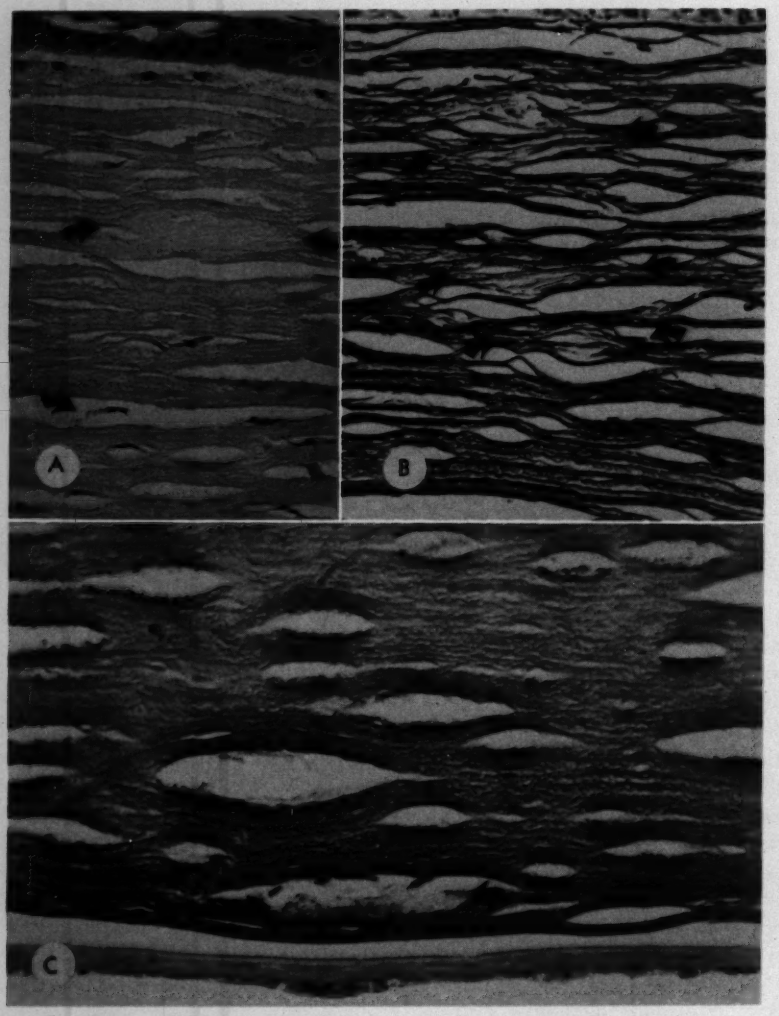

Fig 7 (Jones and Zimmerman). Most of the arrows in (A) and (B) indicate small focal intralamellar lesions. In the lower left corner of (A) the nucleus of a corneal corpuscle is seen near a collection of granulated material. A larger interlamellar lesion is indicated by arrows in (C). (A) Hematoxylin-eosin, ×305, AFIP Acc. 840032. (B) Wilder's stain, ×305, AFIP Acc. 840032. (C) AMP, ×440, AFIP Acc. 840032.

trophy, it was not necessary to depend entirely on the PAS reaction or on birefringence. It was usually possible to distinguish between these two dystrophies on the basis of the morphology of their lesions in sections stained with hematoxylin and eosin and examined with ordinary transmitted light. The lesion typical of granular dystrophy was usually larger and appeared to be an aggregation of distinct, hyaline granules (fig. 11). Smaller granules of a similar nature were often located nearby. Frequently these aggregations presented a somewhat rectangular outline, and their edges were usually irregu-

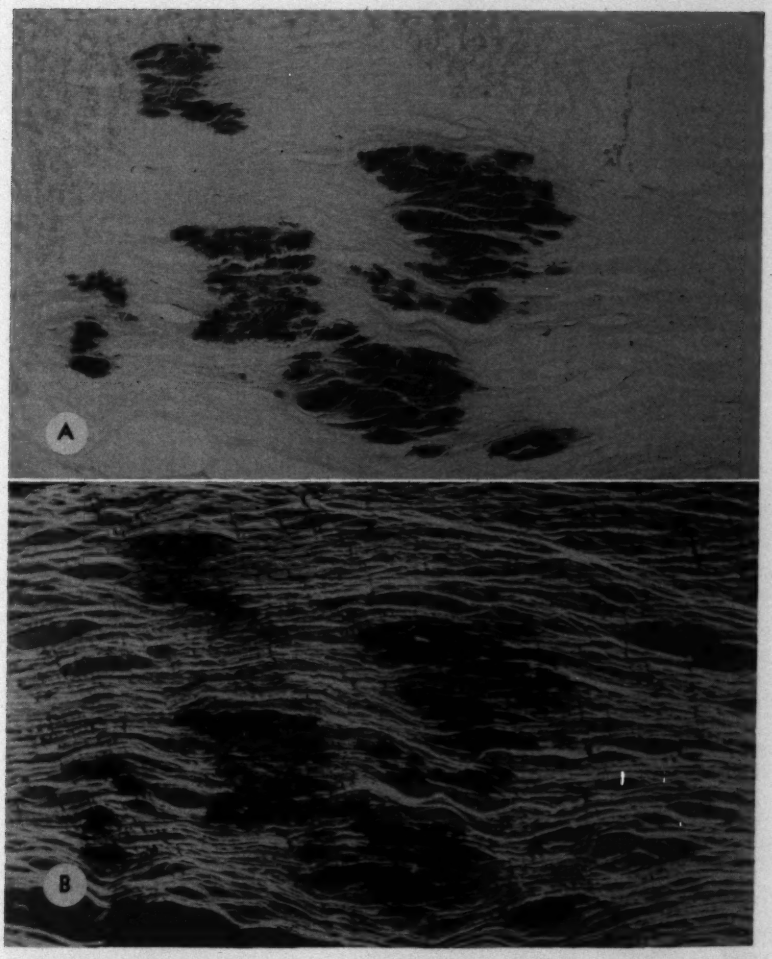

Fig. 8 (Jones and Zimmerman). The typical stromal lesions of granular dystrophy are less birefringent than the surrounding corneal stroma. (A) Hematoxylin-eosin photographed with ordinary illumination, ×115, AFIP Acc. 943178. (B) Same field photographed with polarized light.

larly lobulated (figs. 1, 4, 8, and 11).

The lesions of lattice dystrophy tended to have a fusiform outline with the long axis parallel to the plane of the corneal lamellae (fig. 3-B and color plate). They appeared to be composed of elongated irregular fibrillar material, which was sometimes fragmented. In lattice dystrophy sometimes only a few stromal lesions were seen, and these were often located at the periphery of the tissue excised at the time of keratoplasty. Usually the lesions of lattice dystrophy were less eosinophilic than were those of granular dystrophy.

The stromal lesions of all three dystrophies were beautifully demonstrated in preparations stained with Wilder's reticulum stain. In granular dystrophy, the stromal lesions contained markedly argyrophilic fibers which sometimes appeared to be balled-up like a tangled mass of yarn (fig. 12). In macular dystrophy only a few fragments of argyrophilic fibers usually remained in the

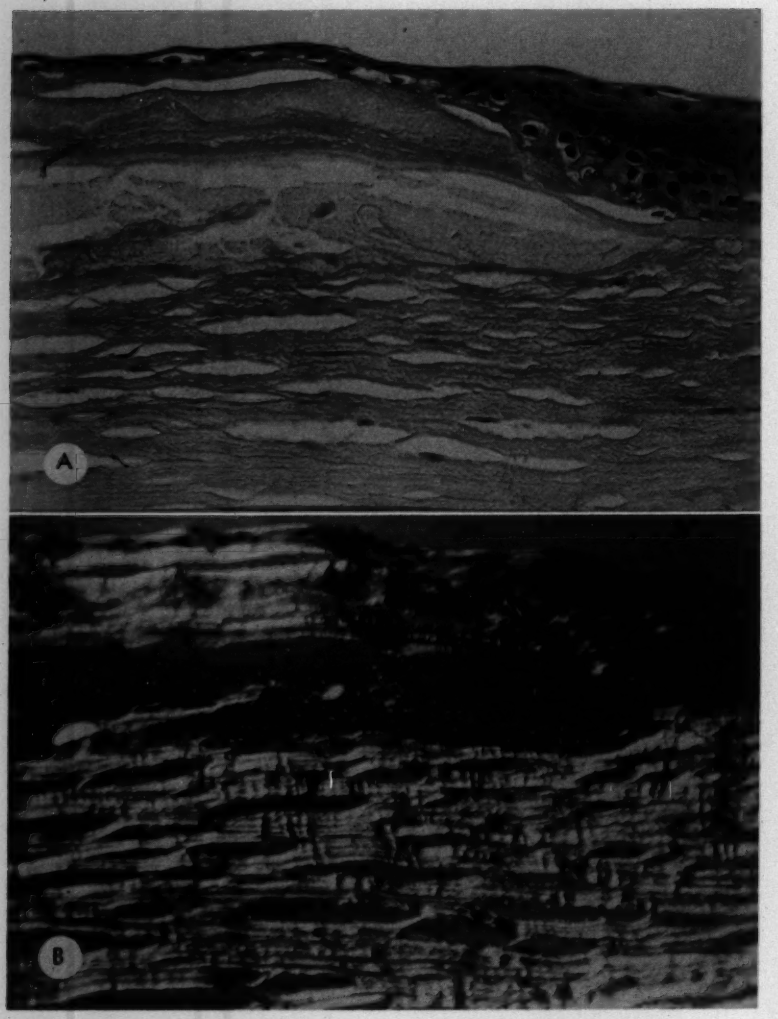

Fig. 9 (Jones and Zimmerman). The typical stromal lesions of macular dystrophy are less birefringent than the surrounding corneal stroma. (A) Hematoxylin-eosin, ordinary illumination, ×305, AFIP Acc. 840032. (B) Same field photographed with polarized light.

larger lesions (figs. 2-C and 5-C), and even in the small focal intralamellar lesions the argyrophilic fibers appeared more widely separated than in the unaffected lamellae (fig. 7-B). In lattice dystrophy the fusiform stromal lesions sometimes contained coarse argyrophilic fibers passing in the long axis of the lesions (fig. 13).

In both lattice and granular dystrophy, when lesions involved all levels of the stroma, they tended to be of about the same size, while in macular dystrophy the largest lesions were usually situated in the most superficial portions of the stroma.

Descemet's membrane and endothelium

Granules or globules were consistently found in the endothelial cells in macular dys-

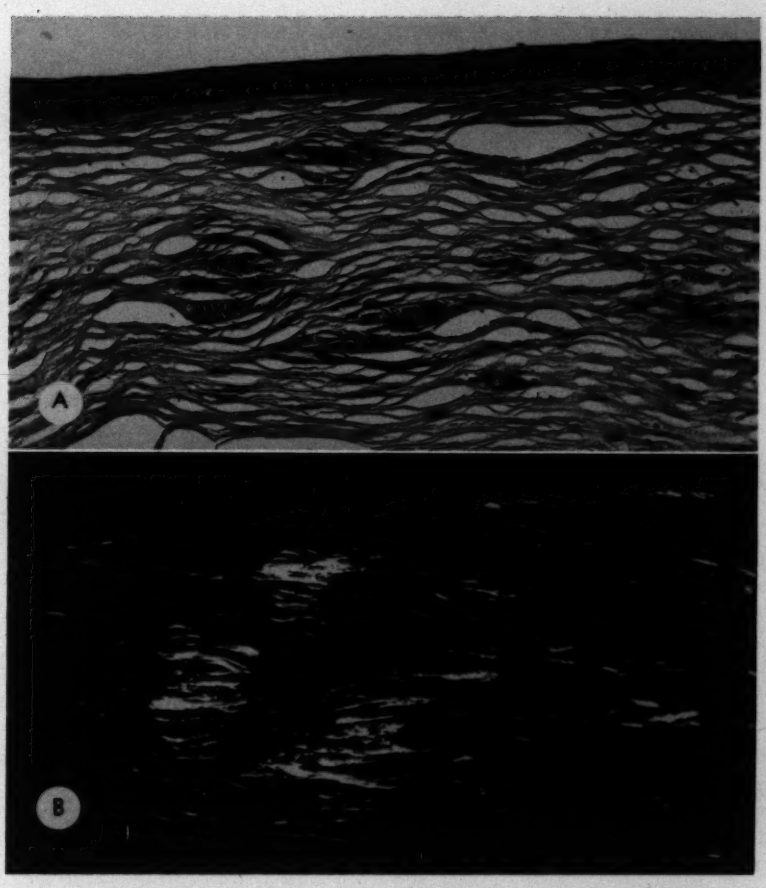

Fig. 10 (Jones and Zimmerman). The typical stromal lesions of lattice dystrophy are more birefringent than the surrounding corneal stroma. (A) Masson's trichrome stain, ordinary illumination, ×130, AFIP Acc. 943176. (B) Same field photographed with polarized light.

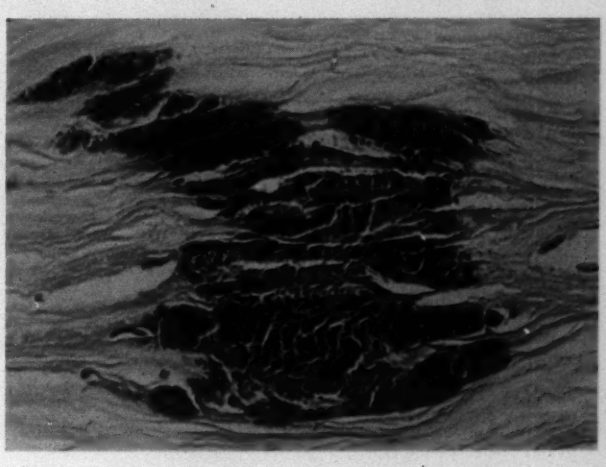

Fig. 11 (Jones and Zimmerman). The characteristic stromal lesions of granular dystrophy appear to be composed of coarse and fine hyaline granules. They often present an irregularly rectangular contour. Hematoxylin-eosin, ×600, AFIP Acc. 943178

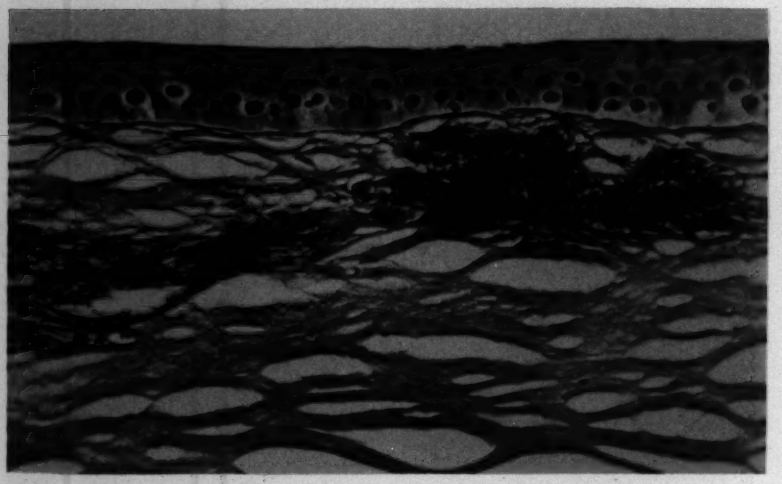

Fig. 12 (Jones and Zimmerman). Demonstration of argyrophilic fibers in stromal lesions of a case of granular dystrophy. Wilder's stain, ×305, AFIP Acc. 929101.

trophy cases. These granules or globules showed the same staining reactions as the masses of amorphous material found in the stroma. In six of the 11 cases of macular dystrophy, there was diffuse or nodular thickening of Descemet's membrane reminiscent of the alterations that are seen in endothelial dystrophy (guttate keratopathy) (fig. 14).

In only one of the six cases of granular dystrophy were there excrescences of Descemet's membrane like those seen in endothelial dystrophy. In the granular dystrophy cases the endothelial cells contained no granules or globules like those seen in macular dystrophy.

None of the cases of lattice dystrophy showed any abnormality of Descemet's membrane or the endothelium.

Summary

1. Histologic examinations were performed on portions of the cornea removed from 24 patients who, on the basis of clinical examinations, had either granular, macular or lattice dystrophy. Six of the 24 patients had granular dystrophy, 11 had macular dystrophy, and seven had lattice dystrophy.

2. In histologic sections from all three types of dystrophy, a variety of nonspecific alterations was found in the epithelium and in Bowman's membrane.

3. Lesions of diagnostic significance were found in the stroma in all of the 24 cases included in this study. While the stromal lesions of granular and lattice dystrophy had certain staining characteristics in common, they could be differentiated on the basis of morphologic features, birefringence, and in-

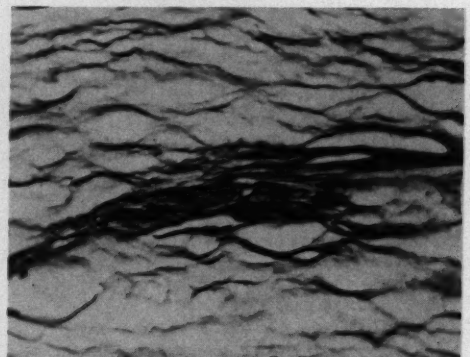

Fig. 13 (Jones and Zimmerman). Appearance of argyrophilic fibers in stromal lesion of a case of lattice dystrophy. Wilder's stain, ×305, AFIP Acc. 220210.

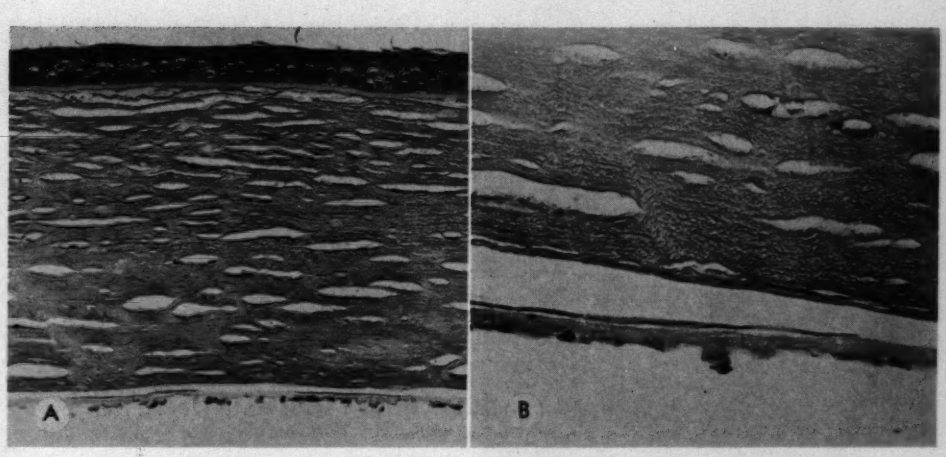

Fig. 14 (Jones and Zimmerman). Diffuse and nodular thickening of Descemet's membrane in center of cornea in a case of macular dystrophy. (A) Hematoxylin-eosin, ×165, AFIP Acc. 840032. (B) Hematoxylin-eosin, ×440, AFIP Acc. 840032.

tensity of staining with the periodic acid-Schiff reaction. Entirely different stromal lesions were seen in cases of macular dystrophy, the most conspicuous lesions being large accumulations of granulated material which gave positive staining reactions for acid mucopolysaccharide.

4. The endothelium and Descemet's membrane were normal in all the cases of lattice dystrophy. All the cases of macular dystrophy showed alterations in the endothelium, and there were frequently changes in Descemet's membrane. In one of the six cases of granular dystrophy there were excrescences on Descemet's membrane; the endothelium appeared normal in all the cases of granular dystrophy.

5. Granular, macular, and lattice dystrophies of the cornea can be clearly distinguished from one another by relatively simple methods of histologic examination.

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LOW VACUUM DIAGNOSTIC CONTACT LENSES*

Description of a series of self-attaching lenses to be used for diagnostic purposes

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In a previous article‡ was described a system to fix diagnostic contact lenses to the eye by producing a negative pressure between the cornea and the contact lens. To effect this a small hole was drilled into the lens, through which a slight suction force of a rubber suction cap could be imparted to the corneal chamber of the lens by means of a highly flexible polyvinyl-chloride tube.

The method has proved very satisfactory for it solves nearly all practical difficulties in the use of diagnostic contact lenses. Some of its advantages are:

1. Air bubbles behind the lens are easily disposed of, when attaching the lens.
2. No air will return during the examination.
3. There is no need for manual holding of the lens, which adheres spontaneously to the cornea.
4. Rotation of the lens is easily effected, as it slides on the natural bearing of the corneal rim.
5. A perfect and constant centering is obtained.
6. The lens follows the eye in every direction of gaze.
7. By means of the contact lens, the eye can be moved against the opposing forces of the external muscles.
8. The usual scleral haptic part and blepharostatic devices of other, not self-attaching, contact lenses have become superfluous.
9. The system allows the application of new construction. Both lighter and bulkier contact lenses are now feasible. Existing contact lenses could be reconstructed on the low vacuum principle and new designs could be realized.
10. Removal of the contact lens is more simple than usual, as the lens will drop off spontaneously on breaking the vacuum.

A disadvantage of this type of contact lens is that too powerful a vacuum may be created. Only a *low* vacuum will prevent such physiologic side-effects as the production of Sattler's veil and blocking of the outflow channels of Schlemm's canal. A prolonged use of the lens is to be avoided, as the lens interferes with corneal oxygenation. However, since a nontraumatic, stable connection between the lens and the eye is obtained, which prevents formation of air bubbles and sliding, it is easy to perform any diagnostic procedure and be finished with it before any ill-effects are produced. In view of the slight angle-blocking effect, usually

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* From the University Eye Clinic. Head: Prof. Dr. H. M. Dekking. These lenses are manufactured under the trade name of Lo-Vac lenses by the Medical Workshop, Kraneweg 94-96, Groningen, Holland. They are sold in the United States by Titmus Optical Company, Petersburg, Virginia.
† Instrument maker, Groningen, Holland.
‡ Om. J. Ophth., **48**:849 (Dec.) 1959.

betrayed by blood filling of Schlemm's canal, it seems inadvisable to use the lens on patients who obviously have closed-angle glaucoma.

Although a diagnostic low vacuum contact lens is more simple and exact than existing lenses, good application still requires some practice.

Instructions for use

Vacuum serves only to counteract gravity

Since it only prevents the lens from falling off, the lowest possible vacuum is sufficient. There is no point in increasing the suction above the bare minimum, as the lens will never fall off, nor be squeezed out, the reason being that the squeezing force of the eyelids is equally distributed between the upper and the lower lids and the final force for squeezing out is nil. Only Bell's phenomenon may push off the lens. This again is prevented by asking the patient to keep his other eye open.

In practice the lens and the attached suction system are filled with distilled water, or slightly hypertonic salt solution (*no* methocel), like a fountain pen, by repeated squeezing of the bulb. Next the corneal hollow of the lens is also filled with fluid and the lens is brought in contact with the cornea; the cup of the lens should be directed upward and the patient should look *down* (fig. 1). The absence of a scleral rim makes this a very simple and controllable procedure.

Just before complete contact is made with the cornea, the rubber bulb is pressed very lightly. On completing the contact, the lens will adhere spontaneously to the cornea. No indentation in the rubber bulb should be visible; if the bulb is indented too much vacuum has been applied.

A simple method to find the lowest possible vacuum is the following: after the lens has been attached, the polyvinyl-chloride cannula is closed by squeezing it. The suction tube is detached and reattached *without suction*. The suction force remaining in the cannula is now redistributed over the whole system and the desired low vacuum is attained.

Fig. 1 (Worst and Otter). Method of attaching a low vacuum contact lens (shown the direct goniolens). The patient is looking down. The left hand lifts the upper eyelid. The right hand holds both the lens (with the corneal hollow upward) and the suction tube.

Do not try to express air by squeezing fluid from the rubber cap. This is very effective but causes too much vacuum. It is better to refill the system and to start anew. In practice this will rarely be necessary.

The examiner should have a piece of adhesive tape or Bandaid ready on his sleeve, to attach the rubber to the *side* of the forehead (not on the front, as the headrest of the slitlamp may interfere). It is practical to attach the contact lens in the examination room before taking the patient to the slitlamp.

To remove the lens the rubber cap is simply detached, or slight positive pressure is applied to the lens by squeezing the bulb.

Fig. 2 (Worst and Otter). The flat minisize low vacuum fundus contact lens, with cannula and suction cap for providing a low vacuum.

When the vacuum is broken, the lens drops off spontaneously. Rinse the lens thoroughly to prevent blocking of the cannula, and keep the lens in a 1/5,000 solution of Zephiran or similar substance, which must be washed out thoroughly before use.

Nine of the low vacuum contact lenses which have been designed have left the experimental stage; the 10th, still in the experimental stage, will be described in a preliminary report. The first four lenses can only be used with a slitlamp:

1. The contact lens for fundus inspection up to the equatorial region.
2. The contact lens for inspection of the fundus periphery.
3. The contact lens for "direct" inspection of the chamber angle.
4. The six-mirror gonioscopy lens for obtaining an over-all view of the circumference of the chamber angle (Goldmann type).
5. The spherical goniolens for "clinical" inspection without a slitlamp (Barkan type).

The following five lenses are for nonoptical diagnostic and surgical techniques:

6. The electroretinography lens (Henkes type).
7. The roentgen reference contact lens for foreign-body localization.
8. The roentgen reference contact lens for bone-free localization.
9. The goniotomy lens.
10. The contact lens for direct and indirect image ophthalmoscopy and gonioscopy (this is a preliminary report on the experimental phases).

1. Fundus contact lens

This contact lens, of very simple design, is representative of any low vacuum contact lens (fig. 2). Its application is extremely easy. The lens itself is a flat-faced corneal contact lens, without scleral or blepharostatic parts. A scleral haptic part proved superfluous, as the cornea already provides a sufficiently large contact area for firm attachment; as no manual contact is needed during the examination, the usual cone, providing support for the fingers, could be dispensed with as well.

The lens transforms the cornea into a flat surface, as shown in the diagram of Figure 3. The slitlamp will provide a clear image of the fundus. Since the lens follows the eye in every direction of gaze, the patient can turn his eye in an off-center position, so as to bring peripheral regions into view. This greatly enlarges the field within reach of this contact lens, as compared with ordinary hand-held fundus contact lenses or the Hruby lens.

This type of lens permits an extensive inspection of all structures of the vitreous interior, of the retina and the choroid, in any plane behind the lens. With low magnification a magnificent stereoscopic over-all view of the contents of the globe will be obtained. High magnifications of the slitlamp will allow inspection of the finest individual capillaries of the retina. Any edema or elevated

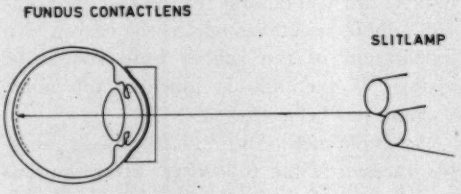

Fig. 3 (Worst and Otter). Diagram of the low vacuum contact lens for inspection of the central parts of the retina.

lesion is readily appreciated because of the stereoscopic slitlamp view. The fundus contact lens is a most senstive diagnostic instrument for early macular lesions.

2. Retinal periphery contact lens

For inspection of regions beyond the equator a marked off-center position of the eye is necessary in this type of direct "mirrorless" fundus inspection. Prismatic errors of the oblique anterior face become too large and total reflection may interfere completely with inspection.

The fundus contact lens for inspection of the periphery of the retina solves this problem. Figure 4 shows the lens, which has an anterior face at 30 degrees to the ocular axis. With the eye in a deviated position, to show the extreme periphery, the anterior face of the lens is still perpendicular to the line of observation of the slitlamp (fig. 5). For different quadrants the anterior face of the lens must be orientated accordingly. This action of rotation of a low vacuum contact lens is most easily performed.

3. Direct gonioscopy lens

The angle of the anterior chamber is invisible by the usual means of inspection of the anterior segment of the eye, as total reflection at the corneal surface prevents obliquely incident rays from reaching the iris root. For gonioscopic inspection several

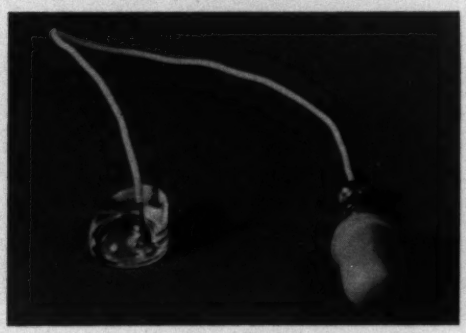

Fig. 4 (Worst and Otter). Retinal periphery contact lens. The anterior face of this lens forms an angle of 30 degrees to the central axis.

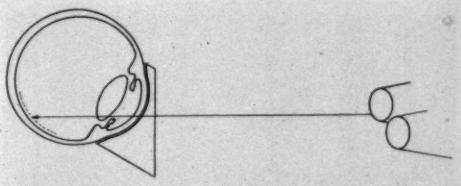

Fig. 5 (Worst and Otter). Diagram of the peripheral retina contact lens. With the line of gaze directed downward, the anterior face of the contact lens still stands at an angle of 90 degrees to the central axis. This set-up is favorable for an undisturbed slitlamp inspection of the peripheral parts of the retina.

contact lenses have been devised. They aim at (1) changing the angle of incidence on the surface and (2) at elimination of the cornea as a refracting medium.

Spherical goniolenses have a more favorable angle of incidence due to the increased curvature of the anterior face. *Mirror* and *prism* goniolenses view the chamber angle via an internal reflecting surface. A spherical goniolens (Salzmann, Koeppe, Barkan) requires inspection from different angles to cover the 360 degrees of the chamber angle. In the mirror type of goniolens (Goldmann) rotation of the reflecting surface around the ocular axis allows full-circle inspection from the slitlamp straight-forward point of view.

Prism goniolenses (Zeiss, Thorpe, Allan, Colenbrander) have several internal reflecting surfaces to produce a composite image of the different parts of chamber angle. Besides several optical limitations, these lenses have the common disadvantage, that they must be held by hand, while the direction of gaze of the patient must be fixed; otherwise air will be sucked behind the lens, breaking the optical continuity with the cornea. Optically the spherical goniolenses are inferior to the internal reflecting types, as they have a limited solving power; however, the reflecting types cause mirror inversion and a considerable "vignetting" of the image, with loss of field.

The "direct" gonioscopy lens shown in Figure 6 presents a new concept in gonioscopy; it has none of the optical disadvantages of existing gonioscopy lenses. This low

Fig. 6 (Worst and Otter). Direct goniolens. Anterior face is 45 degrees to the axis. Polyvinyl chloride cannula attached to rubber suction cap.

vacuum contact lens has a flat anterior face with a 45-degree inclination (fig. 6). Figure 7 illustrates how the lens forms a semipermanent union with the eye. Note the rubber cap fastened with tape to the side of the forehead. The lens has been set for inspection of the nasal chamber angle.

With this lens a half circle of the chamber angle becomes clearly visible, as the optical properties of the flat surface are almost perfect for a detailed wide-angle view. The lens gives a direct view without mirror optics, causing inversion of the image. For this reason the lens is called the direct goniolens. The flat anterior face obtains perfect optics for slitlamp observation with the highest magnifications. The illumination of the chamber angle is superb as the lens causes no dia-

Fig. 7 (Worst and Otter). Direct goniolens, attached to the eye, adjusted for inspection of the nasal chamber angle. The rubber suction cap has been fastened to the side of the head.

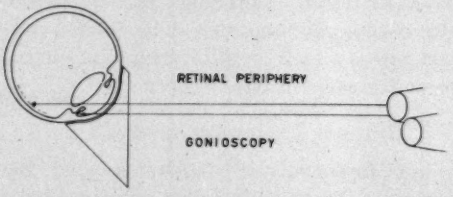

Fig. 8 (Worst and Otter). Diagram of the direct goniolens. The eye with the contact lens is looking down, to give a straight-forward view with the slitlamp of the lower chamber angle. The retinal periphery will also be visible.

fragmation and the flat anterior face is even larger than the cornea itself.

As the lighting is so uncritical, compared with mirror goniolenses, chamber-angle photography through this lens is practical. Any method of anterior chamber photography (iris camera) can now be used to photograph the chamber angle.

This lens not only gives a full 180-degree

Fig. 9 (Worst and Otter). Direct goniolens attached to the eye for inspection of the lower chamber angle. The patient is looking down and the lens has been rotated upward.

Fig. 10 (Worst and Otter). The six-mirror gonioscopy lens. The lens with the detached cannula may also be used without low vacuum.

Fig. 11 (Worst and Otter). The six-mirror goniolens attached to the eye. It provides a composite view of the whole chamber angle.

view of the chamber angle but, as there is no limiting of the field, of at least two thirds of the iris and the rest of the anterior chamber in their natural anatomic relations.

This direct and panoramic view of the whole anterior chamber, including the angle, makes this lens an especially superior instrument for *oblique* anterior chamber inspection. And, as will be evident from the diagram in Figure 8, this new lens also brings the peripheral parts of the retina within reach of the slitlamp. It is, indeed, a lens for anterior segment slitlamp inspection.

To observe a particular area of the chamber angle, the lens must be rotated around the limbus and the patient asked to look in the required direction. Figure 9 shows how the lower chamber angle is inspected. The patient is looking down, while the anterior face of the lens is turned upward.

4. Six-mirror gonioscopy lens (Goldmann type)

This lens is a modification of the original Goldmann gonioscopy lens with one mirror. The six mirrors incorporated in the same inclination provide a composite view of the complete circumference of the chamber angle from the straight-forward view of the slitlamp. With this lens, rotation is scarcely necessary; instead the examiner simply chooses the correct mirror for the particular part of the chamber angle to be inspected.

This type of lens is particularly useful in obtaining an over-all view of the chamber angle and in comparing different parts of it, or for counting goniosynechias.

Figure 10 shows the six-mirror contact lens. Note, that this lens has a scleral haptic part, differing in this respect from the other low vacuum contact lenses. This allows the lens to be used in the classical way, if desired. Figure 11 shows the six-mirror contact lens on the eye.

5. Spherical gonioscopy lens

A modified Barkan-Koeppe gonioscopy lens has been designed. Figure 12 shows this

Fig. 12 (Worst and Otter). The spherical low vacuum gonioscopy lens. In the corneal concavity the exit hole of the cannula is visible. The detachable rubber cap and the polyvinyl chloride cannula are shown.

Fig. 13 (Worst and Otter). The spherical low vacuum goniolens attached to the eye. The rubber cup has been fastened to the side of the forehead. (Chamber angle, X2.)

miniature spherical goniolens. The exit hole of the cannula is visible in the corneal hollow of the lens. The polyvinyl-chloride cannula and the detachable rubber suction cap are also shown.

Figure 13 shows how the lens forms a semipermanent union with the eye. The rubber cap has been fastened to the side of the head. The lens itself keeps the eyelids open, showing that there is no need for blepharostats. The enlarged chamber angle is visible as a dark band.

The lens has an residual magnification of two times, with which the chamber angle becomes visible to the unaided eye. A simple loupe may be used for increasing the magnification. A hand slitlamp is ideal.

The diagram of Figure 14 shows how the whole circumference can be inspected freely, especially when the patient is lying down. The lens is particularly useful in obtaining an impression of over-all relationships in the chamber angle. It seems to be the lens of choice for current clinical use, as it provides its own magnification and does not require a slitlamp. It may be used both when the patient is sitting or in the recumbent position. Because the lens collects light, the illumination is very easy and may be done with an ordinary pocket flashlight. This is another feature which makes the lens very useful for clinical practice.

6. Electroretinography lens (Henkes type)

This electroretinography lens (fig. 15) has a scleral and a blepharostatic cone. The blepharostatic cone can carry different diaphragms. The lens has a cord and plug attachment to the limbal ring electrode. The sturdy and dependable contruction makes the lens a useful instrument for clinical electrophysiology of the eye.

Compared with other types of contact-lens electrodes (the Karpe-Sundmark type), the

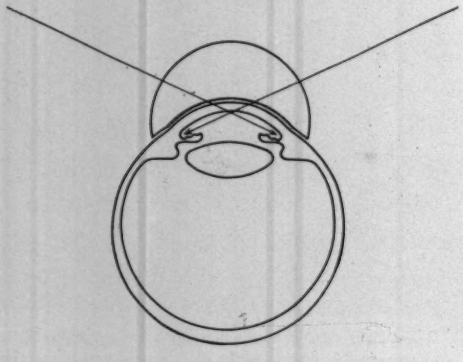

Fig. 14 (Worst and Otter). Barkan goniolens (X2). Diagram of rays of light. With the recumbent patient, the chamber angle will be visible from both the right and left.

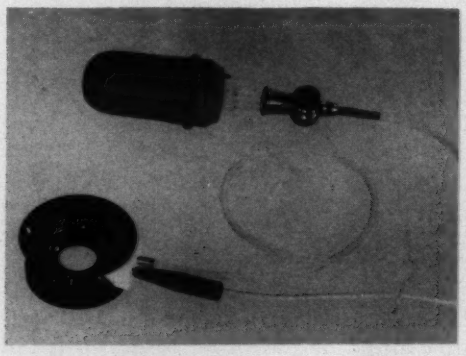

Fig. 15 (Worst and Otter). The electroretinography lens of Henkes. The lens has a limbal electrode, with a cord and plug attachment.

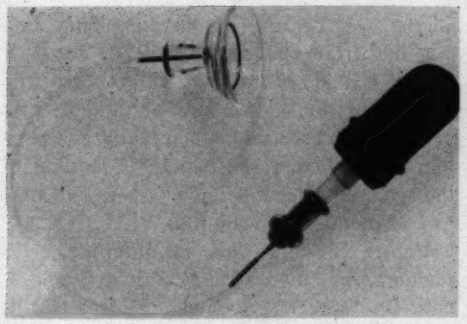

Fig. 16 (Worst and Otter). The roentgen reference contact lens. It has radiopaque parts: a central metal capillary (also for applying the low vacuum) and a limbal ring. The lens is connected to a suction bulb by means of a flexible polyvinyl-chloride tube.

components of the electroretinogram recorded with the low vacuum contact lens are of equal voltage.

The main advantage of a Henkes type lens is that it is possible to prevent movements of the electrode in the electric field of the eye. These movements are one of the main sources of error in electroretinography. In young children and unco-operative patients suction is the only nontraumatic way to assure a constant exposure of the pupil to the stimulating light during the recording procedure (courtesy of Dr. Henkes, personal communication).

7. Roentgen reference contact lens

The low vacuum method for attaching contact lenses proved very useful in the construction of an X-ray reference contact lens for foreign-body localization. This lens is an improvement upon the original Comberg contact lens. The method of application of the lens is simplified, but the actual calculation of the position of the foreign body is taken directly from Comberg's publication.* Figure 16 shows the low vacuum roentgen contact lens with its radiopaque parts (1) the limbal ring 12 mm. in diameter and (2) the central cannula indicating the ocular axis.

The glass has a conically shaped handle. A central perforation runs down to the vertex of the corneal chamber of the lens. The steel capillary, fitting into this central boring, is connected to the rubber suction cap by way of a highly flexible polyvinyl-chloride tube.

The contact lens is applied to the anesthetized eye, after which slight pressure and subsequent release of the rubber cap turn the system into a firm suction apparatus. There is no danger in this type of contact lens, even when a perforation exists. Corneal and scleral perforations will be blocked by this lens, before aqueous or vitreous can be aspired, as experience has shown conclusively. The lens acts as a splint for the injured eye, providing only low vacuum is used.

The lens assumes a perfectly central posi-

Fig. 17 (Worst and Otter). The roentgen reference contact lens on the eye. The handle and the capillary, sticking out between the eyelids, form a clearly visible indication as to the position of the axis of the eye. The eye and the lens form a unit and will move simultaneously. Note how the suction rubber has been fastened to the forehead with tape.

* Comberg, W.: A new prosthesis for roentgenography. Ztschr. f. Augenh., **58**:171-174, 1926.

Fig. 18 (Worst and Otter). Method for taking the anteroposterior exposure. The head is in the nose-chin position. The roentgen reference contact lens is held mechanically in the vertical position by means of a fixation device resting on the roentgen table.

tion of its own accord. This phenomenon is due to the apposition of the corneal and scleral curves of the lens and the eye under the low vacuum conditions. Consequently, displacements of the lens relative to the eye, because of eye movements, are eliminated. However, the actual gripping force of the lens on the eye is such that the eye may be adjusted by means of the contact lens, against the opposing forces of the muscles (fig. 18). The rubber suction cap is attached to the forehead by means of tape.

Figure 17 shows the roentgen contact lens on the eye. Because the steel capillary jutting out from between the eyelids forms a clearly visible pointer with reference to the position of the sagittal axis of the eye, it is most easy to ascertain, when taking the photographs, whether the patient is looking in the required direction, namely, perpendicular to and parallel with the film.

Figure 18 shows how an anteroposterior photograph is made. The head is in the nose-chin position. The roentgen contact lens is held mechanically in the vertical position by means of a special fixation device. The rubber is fastened on the forehead. For the resulting roentgenograph see Figure 20. Figure 19 shows how a lateral exposure is obtained. The patient is given a fixation point for the uninjured eye, to bring the cannula (ocular axis) parallel with the roentgen table. The opposite end of the fixation device of Figure 18 may serve as a guide rule.

In Figure 20, the anteroposterior roentgen exposure, the limbus of the eye is shown by the metal ring. The cannula is photographed as a central dot, unequivocally demonstrating the correctness of the frontal projection. Any

Fig. 19 (Worst and Otter). Method for taking the lateral exposure. The uninjured right eye provides a fixation point in the distance, so as to bring the left eye parallel with the roentgen table. The opposite end of the fixation device of Figure 18 serves as a guide rule.

Fig. 20 (Worst and Otter). The anteroposterior roentgen exposure. The limbus is marked by the ring. The cannula forms a central dot. Note the shadow of the rubber suction cap on the forehead. The foreign body lies in the lower temporal quadrant (see text).

decentration of this cannula betrays an off-center position of the eye. The following measurements are taken: (a) the meridian of the foreign body (in this case: the 210-degree meridian), and (b) the distance from the ocular axis (in this case: 11 mm. from the center). The shadow of the cannula connected to the rubber suction cap is visible on the forehead.

In Figure 21, the lateral roentgen exposure, the limbal ring is shown as a line, which is proof of an exact lateral projection. Only one measurement is taken: the distance of the foreign body behind the limbal plane (in this case: 13.0 mm.).

For the purpose of taking measurements directly from the wet roentgenographs, a special plastic transparent reference template has been made. In Figure 22, it is applied to the anteroposterior exposure of the right eye. On the right is the template for the lateral exposure. The template has been corrected for roentgen magnification (factor 110/100). The template for the anteroposterior graph is a series of 12 concentric rings, spaced at 1.1 mm. The template for the lateral exposure is a rectangular grating of parallel lines, also at a 1.1-mm. interval, with a meridional section of the eye in it.

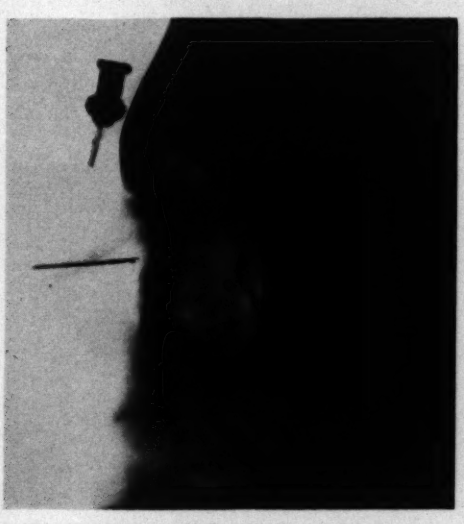

Fig. 21 (Worst and Otter). The lateral roentgen exposure. The limbal ring is pictured as a line. The foreign body is in the lower half of the orbit (see text).

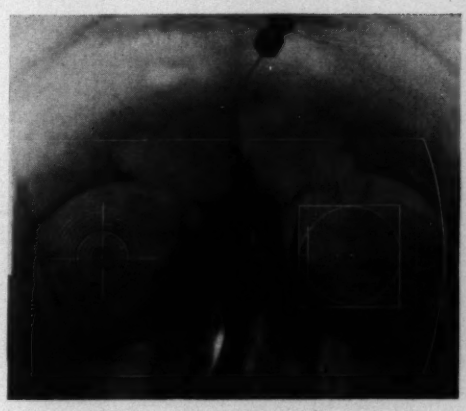

Fig. 22 (Worst and Otter). The transparent reference template applied to the anteroposterior exposure. The foreign body lies 11 mm. from the ocular axis. On the right: the template for measuring the lateral graphs. It represents any meridional section of the eye (not only a vertical one).

The schematic drawing of Figure 23 shows the actual construction of the position of the foreign body from the measurements already mentioned. The site of the foreign body will be expressed in anatomic and surgical terms. Figure 23 (left) shows a frontal exposure. The foreign body lies in the 210-degree meridional plane (line A-B) 11 mm. from the axis. Figure 23 (right) is the meridional section A-B. The foreign body lies 11 mm. from the axis (line C-D) and in a plane 1.3 mm. behind the limbal ring (line E-F). The intersection is the site of the foreign body. The surgical conclusion is that the foreign body will be found at a 13.5-mm. caliper distance from the limbus in the 210-degree meridian.

The method described is an easy, accurate and expeditious one; all necessary data may be obtained within 10 minutes. By controlling it with the Berman locator, we were able to prove its accuracy in a series of 24 consecutive cases.

In cases of foreign bodies at the posterior pole, it is essential to determine the axial

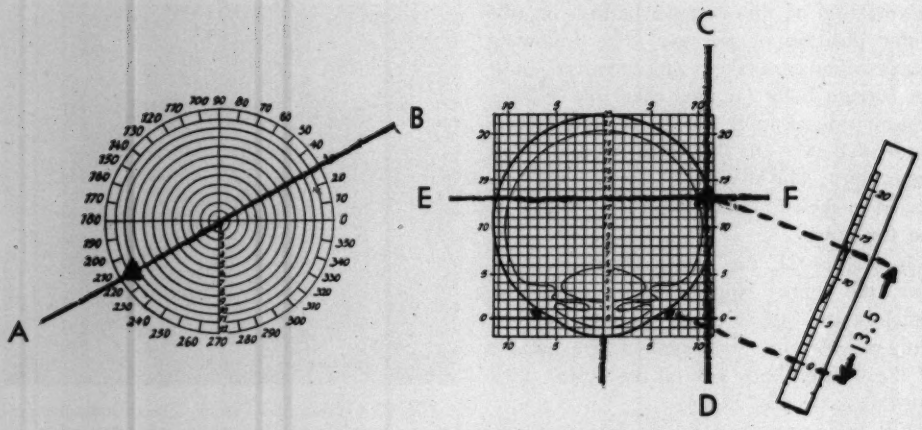

Fig. 23 (Worst and Otter). Construction of the position of the foreign body (after Comberg; see text). The foreign body lies in the 210-degree merjdian at 13.5-mm. caliper distance from the limbus.

length of the eye; to prove that the eye is of standard 24-mm. length, conforming with the transparent template. Figure 24 shows the simple and fairly accurate method of Ambos* to determine the actual length of the eye. With the head in a fixed position, two superimposed roentgenographs have been taken in the lateral exposure. By constructing the intersection of the ocular axes the center of rotation is determined. For practical purposes this coincides with the anatomic center of the scleral curve. As the end of the vertical line marks the limbus, it is now possible to construct the sagittal circumference of the eye and to determine the position of the posterior pole. As this method is well within the possibilities of simple roentgenologic techniques and makes use of the al-

* Ambos, E.: Foreign-body localization by a center of rotation. Klin. Monatsbl. f. Augenh., **130**:37-44, 1957. A similar lens was described independently by Ambos in this publication. Photographs were made by the University Roentgenologic Department (Mr. Raven) and the University Photographic Department (Mr. Smit).

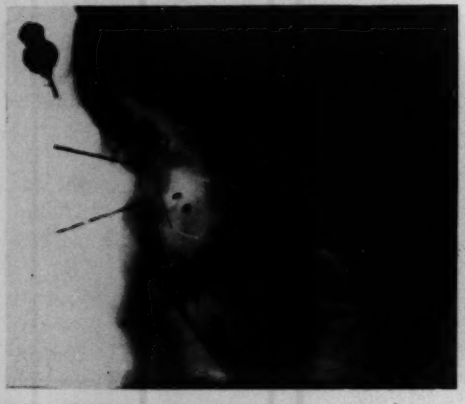

Fig. 24 (Worst and Otter). Construction of the center of rotation after Ambos. Two superimposed exposures are taken on one roentgen film. By lengthening the cannula backward they will intersect in the center of rotation. The radius of the eye is equal to the distance from the center of rotation to the end of the limbal ring.

Fig. 25 (Worst and Otter). The craniocaudal exposure. The dental film is held in an artery clamp and pressed in the lower fornix. The position of the eye is clearly indicated by the long central cannula of the roentgen reference contact lens. The cannula and the film are parallel.

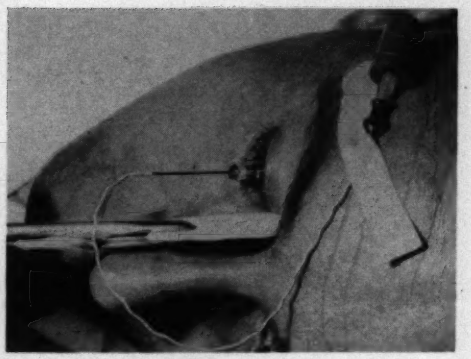

Fig. 26 (Worst and Otter). The lateral exposure. The dental film is pressed in the nasal angle. The ocular axis is parallel with the film, as shown by the central cannula.

ready present roentgen contact lens, it is of great practical value.

8. Bone-free technique for localization of minute intraocuar foreign bodies

The simple roentgenologic technique of bone-free exposure, initiated by Vogt* is executed by pressing a dental film in the lower fornix and the inner canthus, respectively. It is a most sensitive diagnostic method for minute foreign bodies, often revealing them when ordinary radiographs remain negative. Unfortunately this method has only approximate localizing value. This defect is only partially compensated for by inserting metal reference marks in the conjunctiva. The Comberg† localizing shell has also been proposed for bone-free localization; however, constant displacement of the shell on introduction of the dental film invalidates for bone-free purposes this otherwise very exact technique.

It seemed feasible to extend the use of the low vacuum contact lens for roentgen localization to bone-free localization. The lens has the same radiopaque limbal ring. The central cannula, marking the ocular axis, is considerably longer than for the contact lens for normal roentgen localization. The lens centers itself when fastened to the eye with suction from the rubber suction cap. It forms a semipermanent extension to the eye and will not be displaced by rotation of the eye or by the dental film.

Figure 25 of the craniocaudal exposure shows how the film is steadied against the eye by holding the film-case in an artery clamp (also visible as a shadow on the roentgenographs). The central cannula, which forms a pointer sticking out from between the eyelids, greatly facilitates paralleling the ocular axis and the film and obtaining a rectangular relation of these with the central X-ray. The lens with the long cannula is particularly useful for this bone-free technique, as it also serves for mechanical adjustment of the eye.

Figure 26 illustrates the technique for making lateral exposures. The film is pressed in the nasal angle and the cannula is adjusted parallel to the film. The central X-ray should pass through the anterior segment of the eye. Figure 27 is the craniocaudal exposure with the film in the lower fornix. The foreign body lies 2.0 mm. nasal to the vertical plane through the ocular axis (plane C-D of Figure 29). Figure 28, the lateral expo-

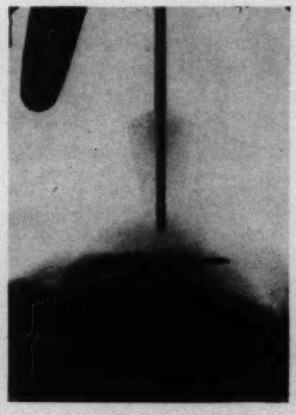

Fig. 27 (Worst and Otter). Craniocaudal bone-free exposure. The outlines of the lens are shown and the shadows of the orbital rim and the eyelids. The foreign body lies 2.0 mm. lateral to the axis and 4.0 mm. behind the limbal ring.

* Vogt, A.: Bone-free roentgenograms of intraocular foreign bodies. Schweiz. med. Woch., **51**: 171-174, 1921.

† Comberg, W.: Ztschr. f. Augenh., **58**:171-174, 1926.

Fig. 28 (Worst and Otter). Lateral bone-free exposure. Shadows of the upper and lower eyelid are visible. The foreign body is 3.25 mm. below the axis and 4.0 mm. behind the limbal ring.

sure with the film in the medial canthus, shows that the foreign body lies 3.25 mm. below the horizontal plane through the ocular axis (plane A-B of Figure 29). In both roentgenographs the foreign body lies 4.0 mm. behind the limbal ring (plane E-F of Figure 30).

The roentgenographs are of a case of traumatic cataract of the right eye, in which a minute foreign body had been diagnosed by means of simple bone-free radiography. As

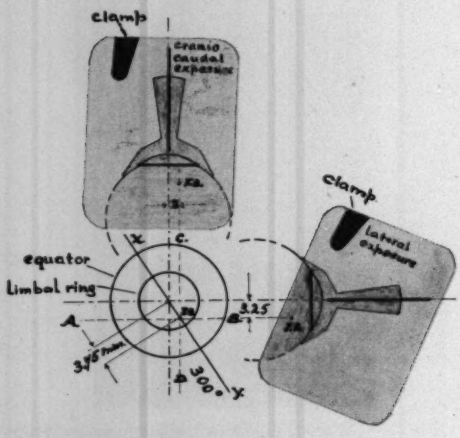

Fig. 29 (Worst and Otter). Reconstruction of foreign body in frontal view.

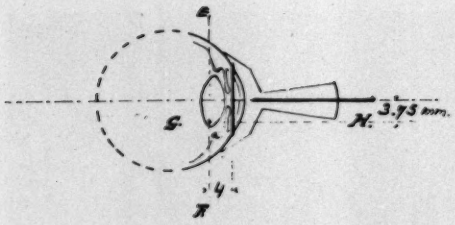

Fig. 30 (Worst and Otter). Site of foreign body in meridional plane X-Y.

proof of the correctness of the projections the limbal ring is shown as a line. The exposures can be made in a few minutes, and the interpretation of the results in even less time.

In the schematic drawing in Figure 29 the site of the foreign body is constructed as it would have appeared on a frontal X-ray exposure. It lies at the intersection of planes A-B and C-D, that is at 3.75 mm. from the axis in the 300-degree meridional plane X-Y.

Localization is now completed with the schematic drawing in Figure 30, which represents the meridional section X-Y of Figure 29 (*not* a vertical section; for details see the previous section). The foreign body lies at the intersection of line E-F, 4.0 mm. behind the limbal ring, and line G-H, 3.75 mm. from the ocular axis.

9. Modified Barkan goniotomy lens*

Goniotomy with the technique of Barkan presents several technical difficulties of which the two more serious are: (1) air getting under the glass and (2) slipping of the lens over the cornea into a decentrated position. With the following modifications of the Barkan goniotomy lens these difficulties would seem to be less.

A metal capillary has been fitted into a hole in the lens, giving access to the corneal chamber of the glass. Through a flexible

* Though this lens looks very similar to a low vacuum contact lens, it should not and cannot be used as such. The low vacuum might increase the pressure in the episcleral veins. Fortunately the hole in the side of the lens, for introduction of the goniotomy knife, excludes vacuum attachment.

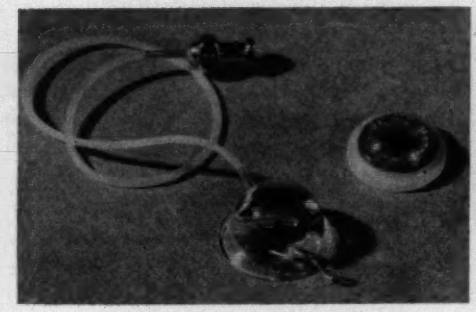

Fig. 31 (Worst and Otter). Goniotomy lens with cannula for washing out air bubbles. A metal pin has been laid in the hole for the goniotomy knife. Behind the lens is an artificial anterior segment.

cannula, attached to this capillary, saline can be injected to wash away air bubbles. This can be done either with a syringe or by continuous drip from a bottle (fig. 31 and 32). The glass has been provided with a rim and four holes. These holes serve to anchor the lens to the conjunctiva by means of sutures. With this glass attached to the eye, it is possible to operate without touching the glass, while air can be driven out through the cannula. The sutures, holding the lens if left uncut, can be used to steady the eyeball.

Incidentally, this glass does not exert pressure on the episcleral veins. Such pressure could cause a rise of pressure in the venous plexus of Schlemm's canal and might explain the hemorrhage, which may occur on opening the chamber angle with the goniotomy knife.

10. Direct and indirect image gonioscopy

This is a preliminary report of a new method for inspection of the chamber angle.

The gonioscopy lens used for this system

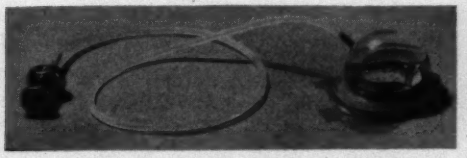

Fig. 32 (Worst and Otter). The goniotomy lens on the artificial eye. The iris root is now clearly visible.

Fig. 33 (Worst and Otter). To the oblique surface of the direct goniolens of Figure 6 a spherical surface has been added. The lens is of the low vacuum type. A rubber cap and a flexible polyvinylchloride cannula serve for attaching the lens to the cornea. The spherical surface focuses parallel rays on the chamber angle.

is a modification of the direct gonioscopy lens (see section 4 of this article).

The flat anterior face of the direct gonioscopy lens has been made spherical (fig. 33). The power of this sphere is such that parallel rays will be focused in the chamber angle. The chamber angle stands in the same relation to this spherical surface as the retina to the cornea.

Since both the retina and the cornea lie in focus in the refracting system, any means for retinal inspection (direct and indirect image ophthalmoscopy in particular) can, in theory, be used for viewing the chamber angle of an eye to which this particular gonioscopy lens has been applied. The lens may be attached to the eye by means of the low vacuum system. A surgical modification has, however, been constructed; this may be sutured to the conjunctiva like the Barkan goniotomy lens.

It would seem quite feasible to obtain a

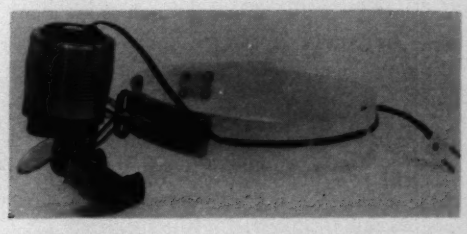

Fig. 34 (Worst and Otter). The indirect image stereoscopic ophthalmoscope can also serve for indirect image gonioscopy.

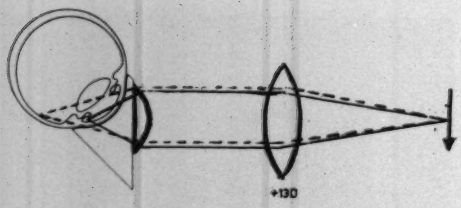

Fig. 35 (Worst and Otter). Schematic drawing of the light rays when performing indirect image gonioscopy. Rays emerging from the chamber angle, leaving the lens parallel, and refocused by a lens of +13D. to form an inverted aerial image (full line). By slight changes of the position of the focusing lens the retina will be visualized (dotted line).

good and markedly enlarged image of the chamber angle with the ordinary direct ophthalmoscope and one application of this lens might be called direct-image goniscopy.

We found, however, that the indirect binocular stereoscopic ophthalmoscope (fig. 34) in combination with this new indirect image gonioscopy lens provides a superior means for inspecting the chamber angle. Direct image inspection is inferior to indirect image gonioscopy for the same reason that it is inferior to the indirect technique, for example, in retinal detachment work.

The system gives a clear stereoscopic view of the chamber angle and under favorable circumstances (like maximum dilatation or a peripheral iridectomy) of the ciliary body, the ora serrata and the peripheral retina (fig. 35).

SUMMARY

A series of diagnostic contact lenses, which can be attached to the eye by slight suction, has been described. Such previous difficulties as air bubbles and manual contact have been eliminated. The system has been used for four types of lenses for gonioscopy and for lenses for inspection of the fundus and peripheral retina, as well as for electroretinography and foreign-body localization.

Van Starkenborghstraat, 10.

AVIAN LYMPHOMATOSIS AND UVEITIS*

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I. INTRODUCTION

The purpose of this paper is to review the literature and to report the clinical picture and histopathology of avian ocular lymphomatosis, a viral disease of chickens, previously considered to be either a nonspecific lymphocytic infiltration of the iris or an anterior uveitis. Since this is a naturally occurring disease, abundant material is available for study if one is willing to search through chicken coops with a loupe and handlight.

II. CLASSIFICATION

Ocular lymphomatosis, also called gray-eye, pearly eye, fish-eye, epidemic blindness, avian uveitis, and avian blindness, is one component of a group of diseases affecting poultry and classified as avian lymphomatosis. Other members of the lymphomatosis group include visceral lymphomatosis and neural lymphomatosis, while some authors classify these diseases in the still larger group of avian leukosis which included erythroblastosis, granuloblastosis, and myeloblastosis. A few authors are of the opinion that Rous sarcoma is an offshoot of this group of diseases.

The generally accepted classification[1] of these diseases places ocular lymphomatosis as one of the three forms of lymphomatosis and separate from the other avian leukoses.

III. HISTORICAL DEVELOPMENT

In 1907, Marek[2] reported four roosters affected with paresis of the wings and muscu-

* From the Wilmer Ophthalmological Institute of The Johns Hopkins Hospital and University. This work was sponsored, in part, by USPHS Grant B-43 (C11), Etiology and treatment of uveitis.

lar atrophy. These birds also showed gross enlargement of the peripheral nerves. Microscopically, the specimens showed dense infiltration of the nerves by mononuclear cells and loss of nerve substance. The spinal cord also showed cellular infiltration. There was no mention of eye lesions in this report.

In 1921, Kaupp[3] reported cases of the paralytic or neural form of the disease in North American fowl with neurologic symptoms similar to those reported by Marek. He also called attention to partial blindness in some of these birds. The eyes were not studied pathologically by this author, however.

Van der Walle and Winkler-Junius[4] described a seemingly similar condition in fowls in the Netherlands in 1921 but no ocular lesions were noted. L. P. Doyle[5] in 1926, wrote an excellent paper describing the clinical and pathologic findings in the neural form of the disease and again called attention to the coexistent iritis and contracted, nonresponsive pupils. In 1927, this same author[6] stated that the iritis and paralysis were probably parts of the same disease, and noted iritis, iridocyclitis, gray irises, and abnormally convex corneal surfaces which suggested increased intraocular pressure.

In one of the classic papers on this subject, Pappenheimer,[7] et al., in 1929, described the clinical and pathologic findings in the visceral and neural forms of the disease and noted that apparently healthy birds showed pathologic evidence of lymphomatosis at postmortem examinations. The ocular form received cursury treatment. Two birds with ocular symptomatology without other manifest symptoms were noted, however.

In 1929, McGaughey and Downie[8] reported a spontaneous outbreak of fowl paralysis in England with iritis being present more commonly than previously reported. The authors doubted that iritis was an essential part of the disease, however.

Patterson, et al.[9] in 1932, in describing lymphomatosis under the name of range paralysis, again called attention to the iris and pupil changes, impaired vision, and occasional blindness and also mentioned the occurrence of corneal opacities. In a series of experiments, a suspension of affected tissue from the neural form of the disease was injected intraperitoneally in unaffected chickens and two months later, the chickens became affected with all three forms of the disease, including the ocular form. Further, a group of affected females, none with ocular disease, were mated with healthy males and in two years after birth, 51 percent of the offspring developed lymphomatosis. Of those affected, 17 percent had the ocular form. All females of this first generation, both visibly affected and unaffected, were then mated again with normal males and in one year after birth, one half of the offspring developed lymphomatosis. However, in the second generation, 93 percent of the affected chickens had the ocular form of the disease and none had the neural form. No explanation was offered for this phenomenon.

Hepding,[26] in 1936, showed that 41 percent of the offspring of chickens with the nonocular form of the disease also had the ocular form. He further showed that chickens inoculated with material from the nonocularly involved chickens developed the eye lesions.

Findley and Wright,[10] in 1939, wrote an article entitled, "Ocular lesions in epidemic blindness in fowl," in which they described the clinical and pathologic findings in this disease and called attention to the infiltration of the chamber angle and Schlemm's canal with plasmalike cells. The cornea was said to be uninvolved. They also described cellular infiltration in the optic nervehead and nerve-fiber layer of the retina, and noted lymphocytic infiltration of the optic nerve and of the occipital lobe of some chickens. They concluded that epidemic blindness per se is a symptom of lymphomatosis and can be regarded as pathognomonic of that disease.

All authors did not agree on this relationship, however, and Bayon,[11] in 1936, in reporting on "Primary iridocyclitis in fowl" felt that this condition was distinct from

lymphomatosis. Bayon reached this conclusion because he could find no existence of neural or visceral lymphomatosis in birds with ocular involvement at post-mortem examination. Bayon also divided the disease into three stages using an arbitrary division of the clinical signs and pathologic findings. There is a conspicuous absence of reports of retinal pathology in Bayon's paper. Interestingly, however, pigment is reported clogging the lymphocytes in the second stage of this disease in his chickens.

Many reports then appeared in the literature attesting to the widespread distribution of the disease, with Emoto and Myamoto,[12] reporting its occurrence in Japan in 1930, while an excellent article by McLennan[13] reported the occurrence of lymphomatosis in Australia for the first time in 1931. Galloway[14] first described the disease in England in 1929. Many papers then appeared describing outbreaks of lymphomatosis and most authors agreed that iritis is definitely part of the clinical syndrome, but few did pathologic examinations of the eye. Johnson and Wilson,[15] and Warrack and Dalling[16] both reported outbreaks associated with iritis, but neither studied the eyes pathologically. In 1936, Patterson,[17] reported on lymphomatosis in the United States and commented on "melanotic neoplastic formations" which he occasionally noted in some of the affected eyes.

With the viral etiology of this disease being generally accepted in the middle and late thirties, the major portion of the recent literature was devoted primarily to transmission experiments via injection of involved tissue, exposure to contaminated pens, chicken-to-chicken transmission, and transmission via the egg to the next generation, all of which were shown to be routes of transmission of the disease.

A large number of papers in more recent times dealt with the technical aspects of the virus isolation and the characterization of the virus isolated. Many authors felt that one strain of virus caused the entire group of avian leukoses,[18] while others felt that lymphomatoses were distinct from the leukoses and caused by a totally different virus. Furth[19] felt that each virus strain had a definite but wide pathologic range.

This dispute persists up to the present day, with Campbell[20] in 1956, stating strongly that lymphomatosis and avian leukosis are two separate and distinct entities; while Beard[21] wrote that the virus of visceral lymphomatosis is probably the stem virus of the avian leukosis, the lymphomatosis and even of Rous sarcoma because of immunologic cross reactions between avian leukosis and the sarcoma group.

Burmester,[22] an eminent and especially productive worker in this field, treats the avian leukoses as a family of viruses, each having distinctive features and some common characteristics.

As recently as July, 1959, further information concerning the clinical characteristics of ocular lymphomatosis has been reported. Rigdon[23] reported bilateral cataracts as the presenting symptom in chickens affected with ocular lymphomatosis. The maturity of the involved lenses varied from almost mature up to morgagnian type cataracts. The offspring of these affected chickens developed the more typical forms of the disease with iridocyclitis, cloudy anterior chambers, and posterior synechias. Neural and visceral involvement also occurred in some of the offspring of the chickens with cataracts. Periorbital fat, lacrimal gland, and extraocular muscles were also noted to be infiltrated by lymphocytes in these studies.

Bridges and Flowers,[24] in 1958, reported an almost identical clinical picture in a group of birds said to have encephalitis. The pathologic descriptions of these eyes seem to be related to those reported by Rigdon but, because no iris deformities were seen in these chickens, the authors felt that the chickens did not have avian ocular lymphomatosis. The birds did have diffuse lymphocytic infiltration of the visceral organs in some cases, while others showed perivascular lymphocy-

tic cuffing and infiltration of the brain and spinal cord. Rigdon states that the pathologic changes described by him are identical to those described by Bridges and Flowers.

To date, there is no report of this disease in the ophthalmic literature, and no ophthalmologist has studied this disease in regard to its ocular symptomatology and pathology. These birds have not been examined with ophthalmic instruments previously, nor has the disease been studied as an example of a naturally occurring uveitis in a species other than man.

IV. Ocular lymphomatosis

Ocular lymphomatosis, the form of the disease of primary interest to ophthalmologists, is an anterior iridocyclitis caused by a viral agent. The infection may be acquired either in embryo through the egg, by direct contact with infected chickens, or from contaminated food, water, coops, feces and handlers. The incubation period of the disease is more than two months. As far as can be determined, no one has successfully transferred the disease directly from eye to eye.

The clinical symptomatology and histopathologic findings which are described in this paper are from eyes in various stages of the disease selected from approximately 200 chickens examined in the flocks on the Eastern Shore of Maryland. Each chicken was examined with a handlight and loupe, and any chicken in which there was a suspicion of the ocular disease was taken to the laboratory of the Regional Poultry Diagnostic Center of the University of Maryland, Salisbury, where facilities were made available through the courtesy of Dr. I. Moultroup. Each chicken was then carefully examined externally with a hand light, with a Bausch and Lomb hand slitlamp, and by indirect ophthalmoscopy with a Schepens indirect ophthalmoscope. The eyes were then photographed, enucleated, fixed in formalin, decalcified, sectioned, and stained in the Wilmer pathology laboratory. This paper is

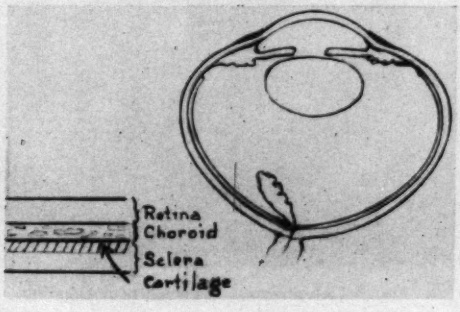

Fig. 1 (Abrahams). Diagram of chicken eye.

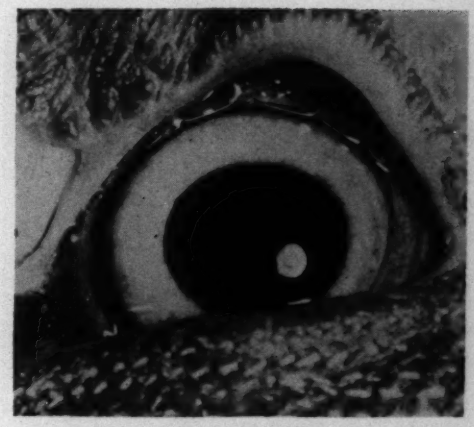

Fig. 2 (Abrahams). Photograph of normal chicken eye.

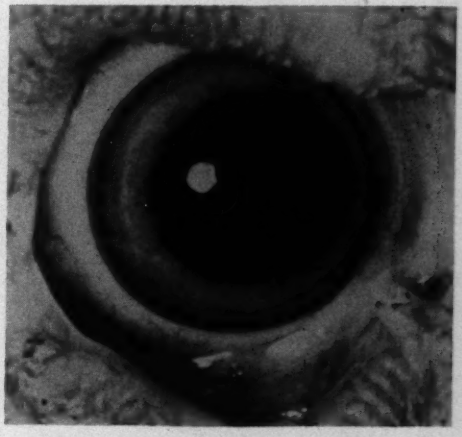

Fig. 3 (Abrahams). Early grayish discoloration of the iris.

Fig. 4 (Abrahams). Localized atrophy and peaking of the pupil.

based on 14 selected eyes, ranging from the normal to the most advanced disease.

V. Orientation

The chicken eye (fig. 1) has similar component parts to that of the human eye with the following exceptions: (a) there is a cartilagenous portion in the sclera; (b) a pecten is present running from the optic disc into the vitreous and containing the ophthalmic artery and vein, its function is entirely unknown; (c) the iris has an endothelial covering on its anterior surface; (d) the chicken has two maculas, one for uniocular and one for binocular fixation. The same histologic layers which are present in the human cornea and retina are also present in the chicken eye.

Fig. 5 (Abrahams). Atrophy of a sector of the iris.

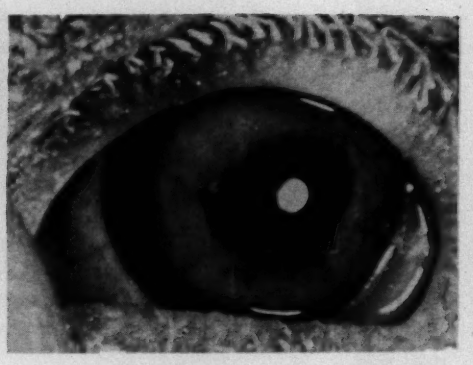

Fig. 6 (Abrahams). Formation of posterior synechias.

VI. External disease

The progression of external changes caused by this disease are depicted in the accompanying illustrations. Figure 2 shows a normal chicken eye with its characteristic orange-brown iris coloration. Early grayish discoloration of the iris appears to be the

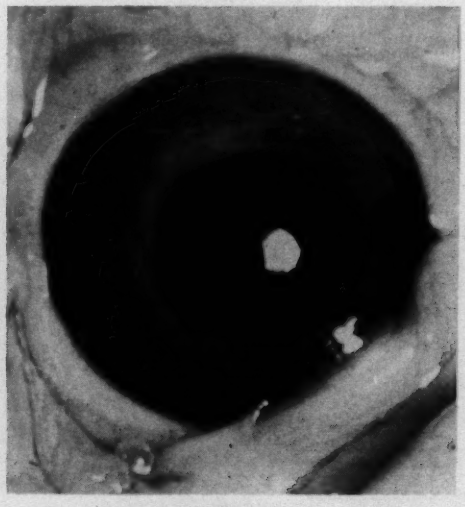

Fig. 7 (Abrahams). Early corneal clouding.

Fig. 8 (Abrahams). Diffuse infiltration of the iris, with blue-gray discoloration.

first clinical sign of the disease (fig. 3). Figure 4 illustrates localized atrophy and peaking of the pupil at the 12-o'clock position, while Figure 5 shows more advanced changes with atrophy of a sector of the iris and focal hemorrhages on the iris surface.

Posterior synechias gradually form as the disease progresses (fig. 6) and corneal clouding develops (fig. 7). The blue-gray discoloration of the iris then occurs, from which the disease gets the name "gray eyes" (fig. 8). Figure 9 shows the more advanced picture with enlarged cornea, total posterior synechia, and a complete pupillary membrane. The external manifestations of this disease thus can be said to range from mild discoloration of the iris, through focal atrophy and posterior synechias, up to buphthalmia, and total posterior synechias with a complete pupillary membrane.

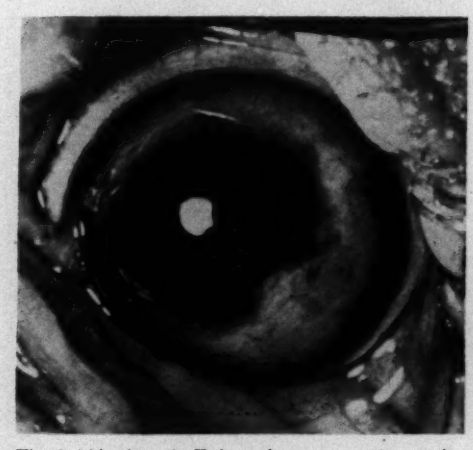

Fig. 9 (Abrahams). Enlarged cornea, total posterior synechias, complete pupillary membrane.

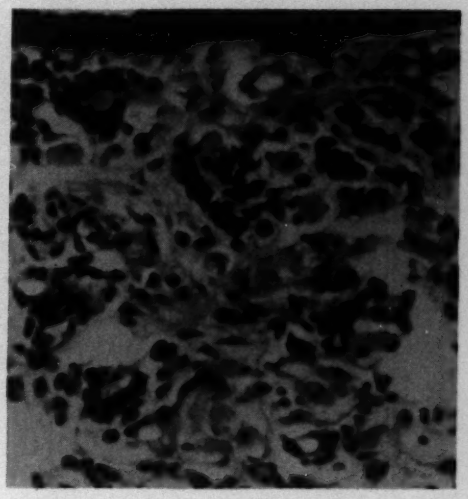

Fig. 10 (Abrahams). Polymorphonuclear and lymphocytic infiltration of the iris stroma.

Slitlamp examination of the eyes in the active stages of the disease revealed a two to four-plus aqueous ray but no cells were seen even in in the more advanced stages, and

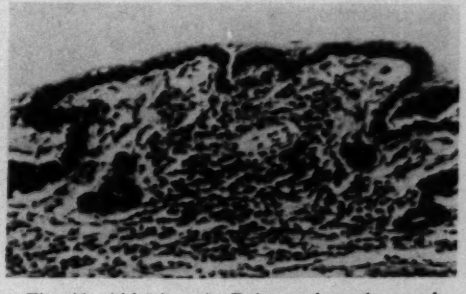

Fig. 11. (Abrahams). Polymorphonuclear and lymphocytic infiltration of the ciliary body.

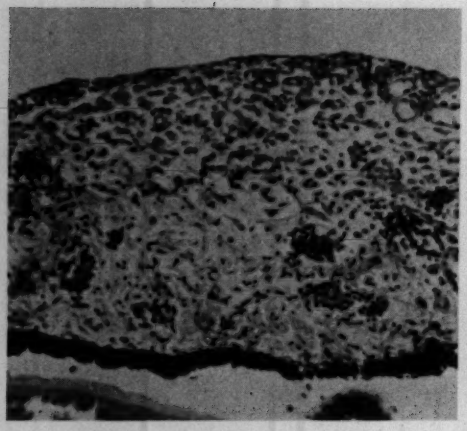

Fig. 12 (Abrahams). Focal lymphocytic infiltration of the iris (low power).

neither ray nor cells were found in the earlier stages. Corneal vascularization at the limbus was noted in those eyes with clouding of the cornea. No keratic deposits were noted in any of the eyes.

In all eyes examined, the disease process was limited to the anterior ocular segment. No lesion of the choroid or retina was seen either with the indirect ophthalmoscope or on histologic examination.

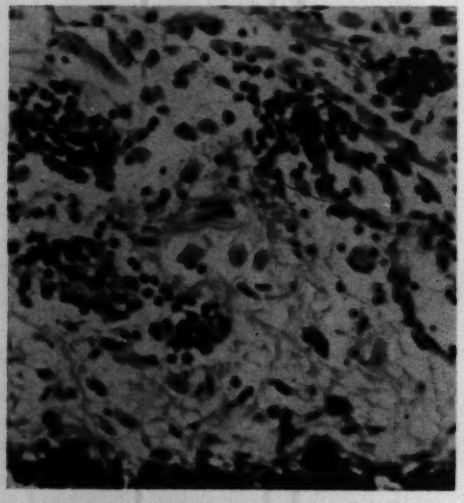

Fig. 13 (Abrahams). Focal lymphocytic infiltration of the iris (high power).

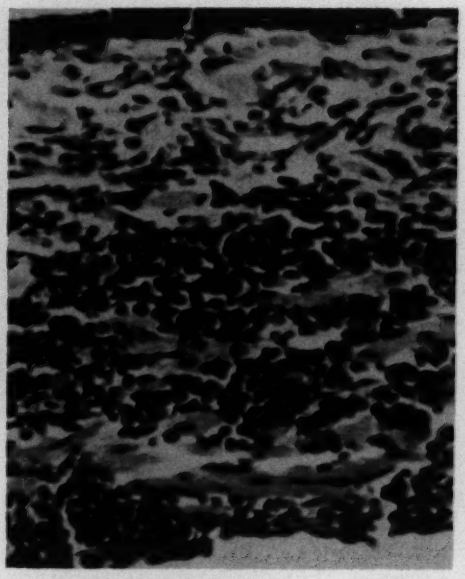

Fig. 14 (Abrahams). Dense lymphocytic infiltration of the iris.

VII. Histopathology

The histopathologic picture of ocular lymphomatosis is: The first cellular response (fig. 10) is a transient polymorphonuclear infiltration of the iris and ciliary body. The polymorphonuclear cell in the chicken has a multilobulated nucleus as in man, but has a red granular cytoplasm as seen in Figure 10. This polymorphonuclear infiltration is

Fig. 15 (Abrahams). Secondary cataract (low power).

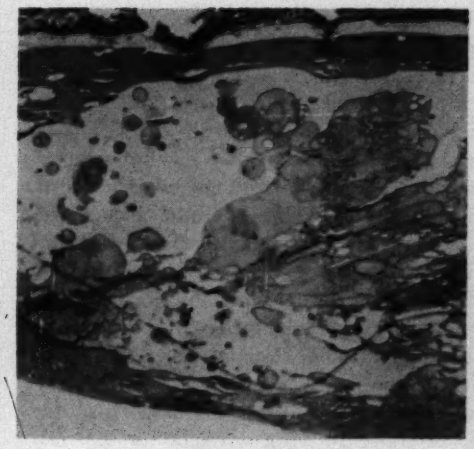

Fig. 16 (Abrahams). Secondary cataract (high power).

rapidly replaced by lymphocytes. In Figure 10, both lymphocytes and polymorphonuclear cells in the iris stroma are seen, while in Figure 11, a similar change is seen in the ciliary body. With the disappearance of the polymorphonuclear cells, the lymphocytic infiltration of the iris and ciliary body assumes a definite focal distribution (fig. 12—low power, fig. 13—high power). The cornea and anterior chamber are uninvolved at this stage.

As the disease progresses, there is a dense

Fig. 17 (Abrahams). Lymphocytic infiltration of the optic nerve.

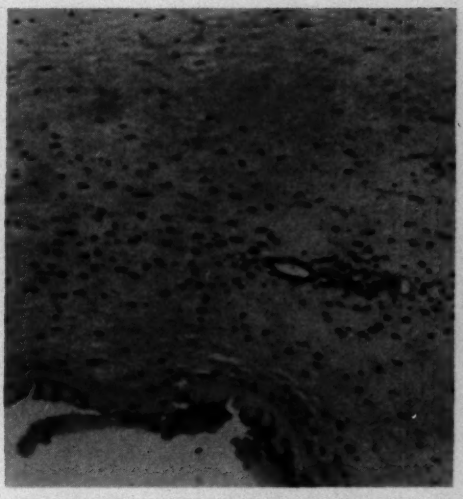

Fig. 18 (Abrahams). Vascularization and polymorphonuclear infiltration at the limbus.

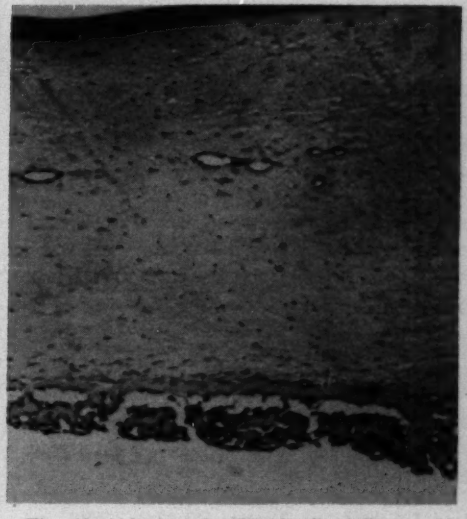

Fig. 19 (Abrahams). "Budding" of Descemet's membrane and endothelium into the anterior chamber (low power).

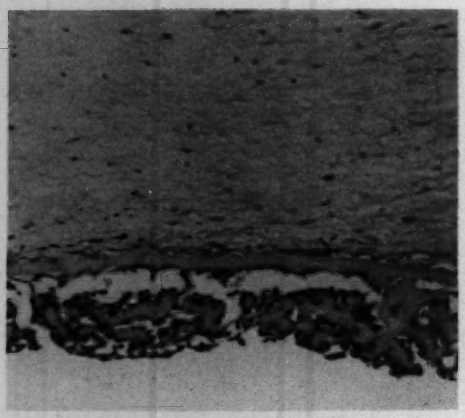

Fig. 20 (Abrahams). "Budding" into the anterior chamber (high power).

infiltration of the iris by lymphocytes (fig. 14), and plasma cells are present in the still later stages of the disease. At this stage, secondary cataracts may be seen (fig. 15—low power, fig. 16—high power). Lymphocytic infiltration of the optic nerve occasionally occurs (fig. 17).

In the more advanced stages of the disease, the cornea shows vascularization and polymorphonuclear infiltration at the limbus and a most striking change in Descemet's membrane and endothelium (figs. 18 and 19). Descemet's membrane appears to undergo an extensive "budding out" process into the anterior chamber. These so called "buds" are covered with one to two layers endothelium, and an occasional lymphocyte is seen adherent to the endothelium (fig. 20). This change has apparently not been described previously in this disease and its closest approximation in human pathology would be the proliferation of endothelium over fibrin in the anterior chamber with the secondary production of a hyalinelike membrane occasionally seen in cases of old tuberculous or luetic interstitial keratitis. In the chicken eye, however, only very early vascularization and minimal keratitis were present. Further, there was no fibrin in the anterior chamber. The etiology and implications of this so-called "budding" are not clear at this time, but one might postulate that they represent a hypersecretion by the endothelial cells, probably in response to viral invasion or possibly merely to inflammation.

VIII. Summary

Ocular lymphomatosis is an acute and chronic iridocyclitis which is caused by a virus. The disease shows a progressively severe clinical picture which can lead to mature cataracts, total posterior synechias, and corneal haziness and vascularization. One bird in this series had apparent glaucoma with megalocornea. So-called "budding" of Descemet's membrane and endothelium in the more advanced cases was noted for the first time in this report.

Although the desire to equate these findings with human uveitis is quite strong, any such attempt at this time would be premature.

The Johns Hopkins Hospital (5).

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EVALUATION OF TELESCOPIC SPECTACLES*

(THIRTY-NINE CASES CHANGED TO SIMPLER LENSES)

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Telescopic spectacles are rarely of any practical value for distant vision. In most cases telescopic units for near vision are not as useful as strong plus lenses, especially in the form of a bifocal.

Stock,[1] Henker,[2] Wolff,[3] Raefler,[4] von Rohr,[5] and Hertel[6] mentioned an occasional success using telescopic spectacles for distance. Henker, an optical physicist, advocated extensive trial periods with telescopic spectacles before they were prescribed. No American ophthalmologist, including Gradle and Stein,[7] Brunner,[8] Mayer,[9,10] Tait,[11] and Kestenbaum,[12] has reported any notable success employing telescopic spectacles for distant use.

The improvement of vision by the use of telescopic spectacles from 20/200 to 20/50 is impressive in the office. This impression is even more convincing when the vision testing is done at 10 feet. The advantages of telescopic spectacles are dramatic while sitting and looking at a visual acuity chart but little opportunity is provided for the disadvantages to become apparent. The disadvantages of telescopic spectacles for distance are: (1) restricted visual field, (2) apparent closeness of objects, (3) apparent motion of objects, (4) inability to see at distance and near simultaneously, (5) objectionable appearance and (6) expense.

Telescopic spectacles which magnify less than two times do not produce sufficient magnification to be worth one's while to prescribe. The restricted visual field of a telescopic spectacle is the most serious hindrance to its use. The clinical visual field of 2.2X

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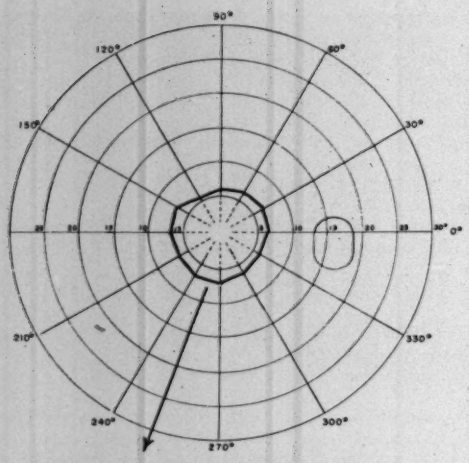

Fig. 1 (Fonda). Visual field of a 2.2X telescopic spectacle at a vertex distance of 12 mm.

magnification telescopic spectacle worn at vertex distance of 12 mm. has been measured on a tangent screen to be 14 degrees as shown in Figure 1. If the patient is not already classified as blind, he becomes blind as soon as he wears telescopic spectacles. A sudden limitation of the visual field is a much greater handicap than a visual field that has become gradually constricted over a period of years. The accepted definition of blindness states that the vision is 20/200 or less in the better eye or vision better than 20/200 with a visual field constricted to 20 degrees or less. There is universal agreement that patients with severely constricted visual fields, such as in retinitis pigmentosa, are unfavorable for low vision corrections.

Only Galilean telescopes consisting of a convex objective and a concave ocular have been successfully adapted for telescopic spectacles. Hugh Dixon[13] patented a Galilean type telescopic spectacle in 1786, using mirrors. The performance of a telescopic spectacle using mirrors, which received international publicity during 1956, was reported in the minutes of the American Committee on Optics and Visual Physiology.[14] The report clearly indicated that this device was of no practical value.

Nonoptical magnification[15] previously described offers much more than telescopic spectacles. A magnification of two times is produced by reducing the distance by half between the observer and the object of regard. The magnification is increased as the distance between the observer and the object of regard is reduced as demonstrated in Figure 2.

This diagram clearly demonstrates how a magnification of 10 times is achieved by moving from 20 feet to two feet from a television set. This principle applies well in the class room. Preferential seating provides two to four times magnification, and walking up to the blackboard produces a magnification of 10 to 20 times. Why wear telescopic spectacles in a class room when the same or greater magnification can be achieved by walking up to the blackboard? This can be done in less time than it takes to put the telescopic spectacles on the face. There is no limitation of visual field, eyes can be immediately used for near vision without changing glasses, and there is no cost. Nonoptical magnification is many times more flexible and much greater than that produced by telescopic spectacles.

Occasionally, special situations occur where a telescopic spectacle may be of value for distance. Pocket magnifiers are generally more useful when it is necessary to read

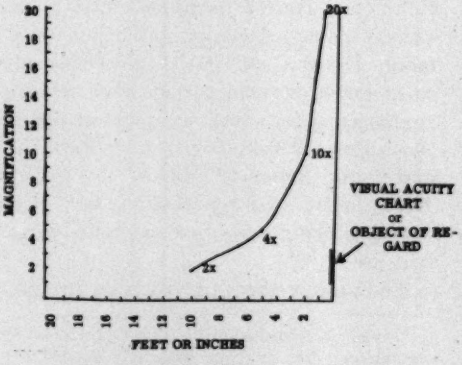

Fig. 2 (Fonda). Magnification increases inversely as distance from object is reduced.

street signs or bus numbers. Sportscopes or opera glasses of three times magnification which can be adjusted to compensate for the patient's refractive error are useful for these situations. Most partially seeing people prefer a full visual field and less central vision for the theater and sporting events. Imagine watching a baseball, football, basketball, or hockey game with a 14-degree visual field. I have not been able to understand the practical advantage to the rare person who does learn to walk about with a telescopic spectacle.

Pathologic myopia has been frequently listed as the primary indication for telescopic spectacles. There are four reasons for this impression: (1) the Jesuit, Francesco Eschinardi,[16] in 1667 gave a two-times magnification telescopic spectacle for near to a myopic patient of about −6.25 diopters which allowed him to read print clearly at 20 inches. He did not recommend telescopic spectacles for distant vision on account of narrowness of their fields; (2) Prof. E. Hertel[6] recommended telescopic spectacles for the correction of pathologic myopia as a substitute for the extraction of the lens; (3) early in the 18th century,[5] when eyeglasses were not yet in general use, myopic patients frequently employed Galilean telescopes (opera glasses) to look at distant objects, particularly in the theater, for short periods. This accounts for the large number of instruments then in use (every near-sighted person was a potential customer); (4) Scott[17] reported that a special form of telescopic glasses was made for high myopia. The result was to increase the visual field at the same time giving clearer definition at its periphery with freedom from distortion.

Fig. 3 (Fonda). Telescopic spectacle, 2.2X magnification.

Fig 4 (Fonda). Actual reading distance while wearing a 2.2X magnification telescopic spectacle with a +8.0D reading cap. Total magnification is 4.4X.

Telescopic spectacles offer no greater advantage for pathologic myopia than any other pathology. In fact, the advantages of telescopic spectacles are less because a myopic patient of −20.00 diopters whose vision is 20/200 can read the equivalent to J1 at two inches from his eyes with no glasses. Contact lenses should always be considered because they increase the size of the retinal image.

The following case is representative of many for which telescopic spectacles have been prescribed when simpler and less expensive glasses, especially bifocals, would have served better.

This 24-year-old man had a diagnosis of postoperative aphakia for congenital cataracts in both eyes, glaucoma and esotropia of the left eye. He had been wearing a 2.2X telescopic spectacle with a +8.0D. reading cap for five years. He found the

Fig. 5 (Fonda). Conventional spectacles with a +16.0D. reading addition.

telescopic unit useful only for reading even though he could read 20/60 with the telescopic spectacles. This man requested a bifocal so he would not need to change glasses. Uncorrected vision was: O.D., 5/125 (20/500); O.S., light perception. Corrected vision was: O.D., 20/160. Near vision: 0.5 Sn. (J-1) at 2.5 inches. The correction prescribed was: O.D., +11.0D. sph. ⌒ +1.0D. cyl. ax. 180°, add +16.0D. sph. (Ultex B); O.S., balance lens (top of segment to come to the lower border of pupil).

Figures 3 through 7 demonstrate the following advantages of bifocals over telescopic spectacles: (1) less objectionable in appearance, (2) permit patients to see both near and distant objects simultaneously without changing glasses, (3) larger reading field, (4) more comfortable, (5) less expensive, (6) requires only one pair of glasses in many cases, and (7) depth of focus greater.

Fig. 6 (Fonda). Actual reading distance with a +16.0D. reading addition. Magnification is 4X.

The only advantage of the telescopic spectacle is that the reading distance is twice as great for the same magnification. In this case the reading distance with the telescopic unit is five inches, whereas the reading distance is two and one-half inches with the bifocal.

Present study

Table 1 is a report of 39 patients who had been wearing telescopic spectacles which

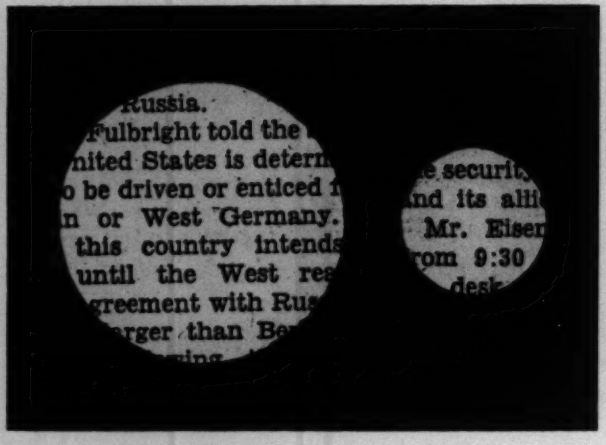

Fig. 7 (Fonda). Comparison of the visual field seen through the bifocal with a reading addition of +16.0D. and the telescopic unit. The field seen through the bifocal is twice that seen through the telescopic unit of approximately the same magnification.

TABLE 1

REPORT OF 39 PATIENTS FOR WHOM TELESCOPIC SPECTACLES WERE CHANGED TO SIMPLER AND MORE DESIRABLE SPECTACLES

(21 were changed to bifocals)

Magnification of Telescopic Spectacle Patient Was Wearing	Primary Diagnosis	Vision	Type of Glasses Prescribed	Age (yr.)
Case 3980 2.2× No Add	Albino	R. 20/200 L. 20/200	R. +0.50 +1.00 × 165 L. +0.75	13
Case 3475 1.7× Add +6.00	Albino	R. 20/120 L. 20/100	R. +3.75 +2.00 × 110 L. +5.50 Add +8.00 (O.D. for distance) (O.S. for near)	17
Case 15587 2.2×	Albino	R. 20/200+ L. 20/140+	R. −3.00 +2.00 × 90 L. −3.50 +2.00 × 80	20
Case 179 2.2× Add +6.00	Albino	R. 20/200 L. 20/200	R. +1.00 +2.50 × 90 L. +1.00 +2.50 × 90 Add +8.00 (Ultex B)	15
Case 205 2.2× Add +8.00	Albino	R. 10/200 L. 20/200	R. −2.00 +3.50 × 90 L. +1.25 +2.00 × 95 Add +16.00 (Ultex B)	32
Case 224 2.2× Add +8.00	Albino	R. 20/200 L. 10/200	R. +2.50 × 97 L. +2.75 × 80 Add +10.00 (Ultex B)	28
Case 1352 2.2× Add +6.00	Albino	R. 20/200 L. 20/140−	R. +3.50 +3.50 × 90 L. +2.50 +3.00 × 90 Add +6.00 (Ultex A)	14
Case 195 2.2× Add +6.00	Albino	R. 10/200 L. 20/200	R. −5.00 +4.50 × 95 L. −3.00 +3.00 × 75 Add +10.00 (2 pair)	41
Case 865 2.2×	Albino	R. 20/140− L. 20/200	R. +1.00 +3.50 × 90 L. +1.00 +3.50 × 90	25
Case 791 1.8×	Albino	R. 20/100 L. 20/100	R. Plano L. −1.25 Add +10.00 (Ultex AL)	47
Case 1093 2.2× Add +8.00 Add +2.00	Albino	R. 2/200 L. 20/250	R. Balance L. −9.50 +2.50 × 90	27
Case 2197 2.2×	Optic atrophy	R. 18/400 L. 12/250	R. Plano L. Plano Add +7.00 (bifocal)	38
Case 14400 2.2× Add +6.00	Optic atrophy	R. 20/200 L. 20/200	R. Plano L. Plano Add +10.00 10^{Δ} base-in (half-eye glasses)	41
Case 15031 2.2× Add +10.00	Optic atrophy	R. 16/200 L. 16/200	R. Plano L. Plano Add +12.00 12^{Δ} base-in (half-eye glasses)	40
Case 675 3× Add +10.00 Sportscope	Optic atrophy	R. 20/100 L. N.L.P.	R. +4.50 Add +7.00 L. Balance (bifocal)	40
Case 227 2.2×	Optic atrophy	R. 3/200 L. 10/200	R. Dummy L. +48.00 (doublet)	46

TABLE 1 (*Continued*)

Magnification of Telescopic Spectacle Patient Was Wearing	Primary Diagnosis	Vision	Type of Glasses Prescribed	Age (yr.)
Case 530 2.2× Add +8.00	Optic atrophy	R. 3/200 L. 10/155	R. Balance L. +16.00 (near vision)	17
Case 936 2.2× Add +12.00	Optic atrophy	R. 20/300 L. 20/400	R. +35.00 (Conoid) L. Balance	78
Case 646 1.7× Add +4.00	Optic atrophy	R. H.M. L. 8/200	R. Balance L. Plano Add +24.00 (bifocal)	26
Case 17303 2.2× Add +12.00	Optic atrophy	R. 12/200 L. 20/350	R. +4.00 L. +4.00 Add +20.00 (Ultex B)	13
Case 9156 1.7× Add +12.00	R. aphakia glaucoma, detached retina L. glaucoma aphakia	R. L.P. L. 20/400	R. Balance L. +5.00 Add +16.00 (Ultex B)	24
Case 13381 2.2× Add +8.00	Aphakia	R. 20/200 L. L.P.	R. +11.00 +1.00 × 180 Add +16.00 (Ultex B) L. Balance	24
Case 8037 1.7× Add +12.00	Aphakia	R. H.M. L. 20/500	R. Balance L. +8.00 Add +10.00 (near vision)	49
Case 626 2.2× Add +4.00	Aphakia	R. 20/140+ L. 20/140−	R. +6.00 +2.50 × 180 L. +5.50 +1.00 × 180 R. Add +14.00 L. Add + 8.00 (Ultex B)	
Case 24 1.7× Add +6.00	Macular degeneration	R. 10/200 L. 10/200	R. Plano L. Plano Add +13.00 (Ultex B)	40
Case 547 2.2× Add +6.00	Macular degeneration	R. 5/200 L. 5/137	R. Balance L. −2.50 +2.50 × 75 Add +40.00 (triplet)	26
Case 1398 2.2× Add lost	Macular degeneration	R. 1/200 L. 20/280	R. Balance L. −13.00 Add +23.00 (near vision)	63
Case 1119 3× Add +5.00 Sportscope	Macular degeneration	R. 10/ 70 L. 10/200	R. +5.00 Add +14.00 L. +5.00 Add +4.00 (half-eye glasses)	80
Case 14654 2.2× Add +10.00	Chorioretinitis	R. 3/200 L. 6/200	R. Balance L. +6.00 Add +24.00 (bifocal)	9
Case 206 2.2×	Chorioretinitis	R. 2/200 L. 20/500	R. −11.00 (for distance) L. −11.00 R. Balance L. +48.00 (aspheric) (for near)	8
Case 162 2.2× Add +8.00	Detached retina	R. N.L.P. L. 20/200	R. Balance L. +2.00 +2.50 × 145 Add +30.00 (bifocal)	49
Case 216 2.2× Add +10.00	Detached retina	R. 10/200 L. 5/200	R. +8.00 Add +28.00 L. Balance (near vision)	38

TABLE 1 (*Continued*)

Magnification of Telescopic Spectacle Patient Was Wearing	Primary Diagnosis	Vision	Type of Glasses Prescribed	Age (yr.)
Case 9342 2.2× Add +10.00	Achromatopsia	R. 20/320 L. 20/320	R. −5.50 L. −5.50 Add +16.50 (near vision)	48
Case 16817 2× Add +6.00	Achromatopsia	R. 20/200− L. 20/400+	R. −2.00 L. −3.00 Add +24.00 (AOC magnification bifocal)	31
Case 248 2.2× Add +6.00	Uveitis	R. 20/140 L. 20/400+	R. +1.50 L. +0.75 +1.00 × 180 Add +13.00 (Ultex B)	57
N.Y.E.E. 2.2× Add +14.00	Pathologic myopia	R. 20/100 L. 2/200	R. −16.50 +0.75 × 100 L. Balance R. Add +32.00 (bifocal)	57
Case 52 2.2× Add +6.00	Congenital cataracts	R. 10/200 L. 5/200	R. +12.00 Add +20.00 L. Balance (bifocal)	37
Case 275 1.8× Add +14.00	Congenital cataracts	R. 8/200 L. N.L.P.	R. +48.00 (doublet) L. Balance	29
Case 17047 2.2× Add +8.00	Retrolental fibroplasia	R. 10/200+ L. N.L.P.	R. +2.00 +1.50 × 10 L. Balance R. Add +16.00 (AOC magnification bifocal)	10

were changed to a simpler and more desirable spectacle. For 21 of these patients the telescopic spectacles were changed to bifocals. I had prescribed telescopic spectacles for a few years before I recognized the advantages of other lenses, particularly bifocals. Some of the patients listed are those to whom I had originally prescribed the telescopic spectacles. Everyone of the following patients has been interviewed by me at an interval of at least two months or more after they had been wearing the lenses which replaced the telescopic spectacles. In every case the patients definitely preferred their new glasses over the telescopic spectacles, and rarely did they find any use for the telescopic spectacles for any occasion.

I had prescribed a +48.0D. doublet for a woman with Harada's disease, who had been wearing a 2.2X magnification telescopic spectacle with a +8.0D. reading addition. After a few months trial, she said that there was not much difference. This case is not included among those reported.

There is an occasional situation in which a telescopic spectacle combined with a reading cap is superior to equivalent or greater magnification in the form of a simple strong plus lens, even when it is made in the form of a bifocal. These situations exist among patients in whose vocations the increased working distance afforded by the use of telescopic spectacles is of paramount importance. I have only examined two patients for whom the telescopic unit for reading has proved to be superior.

The first patient was a 63-year-old man who has worked as a compositor of print since the age of 18. The diagnosis was macular degeneration and mild chronic simple glaucoma.

Vision with the following correction was: R.E., —1.5D. sph., 10/200+ (20/400+); L.E., —4.0D. sph. ⌒ +1.5D. cyl. ax. 180°, 3/100 (20/600). The correction given: R.E., —1.5D., add +24.0D. (AOC magnification bifocal); L.E., balance (top of segment to come to the upper border of the pupil).

This man had been wearing a 2.2X magnification telescope with a +8.0D. reading addition at his work for two and one-half years. The telescopic unit was found much more useful at his work than the magnification bifocal, which I prescribed. He never could use the telescopic spectacle for distance.

The second patient was a 30-year-old man who has been employed as a general helper in a plastics factory for nine years. He requested telescopic spectacles to read pressure gauges at 10 feet, as well as for reading scales on which color pigments were weighed. The diagnosis was optic atrophy.

Vision without correction was: R.E., 20/400; L.E., 20/400. There was no significant refractive error. Vision with 2.2X magnification telescopic spectacle was: R.E., 20/140+; L.E., 20/140+. Correction given: R.E., 2.2X magnification telescope; L.E., 2.2X magnification telescope, add +12.0D. (reads 0.5 Snellen (J-1) at 8.5 cm.). The patient had been using a +24.0D. hand magnifier for two years.

This patient finds the telescopic spectacle useful to read pressure gauges at 10 feet, as well as to read the markings on a small scale. However, he can do most of his work without the telescopic spectacles. This is another case in which a telescopic spectacle could not be successfully replaced by strong plus lenses mounted in a spectacle frame.

Summary and Conclusions

1. Telescopic spectacles are rarely of practical value for distance because (a) useful visual field of 2.2X magnification telescopic spectacle is 14 degrees, (b) objects appear too close and too large and (c) apparent motion of object when head is moved.

If the patient is not already blind by the definition of blindness, he becomes blind as soon as he wears a 2X magnification telescopic spectacle.

2. Nonoptical magnification is much greater and more flexible than that produced by telescopic spectacles. A magnification as great as 20 times is easily achieved by approaching the object of regard.

3. Pathologic myopia is not more favorable for correction with telescopic spectacles than other types of pathology.

4. Ordinary strong plus lenses, especially in the form of a bifocal, are superior to telescopic units for near for the following reasons: (a) appear like conventional glasses, (b) larger field of vision, (c) patient can see both distance and near simultaneously with the same glasses, (d) less expensive, (e) more comfortable, (f) frequently requires only one pair of glasses and (g) greater depth of focus.

5. The only advantage of a telescopic unit for near use is that the reading distance is twice that of a plus lens of equivalent dioptric power.

6. Thirty-nine cases are reported which were changed from telescopic spectacles to simpler glasses, 21 of which were bifocals; every patient definitely preferred the simpler glasses to the telescopic spectacles.

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PTERYGIUM SURGERY*

An evaluation and discussion of various operative procedures with the description of a surgical technique

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I. Introduction

Any pterygium which shows progression by extending over the cornea should be operated upon. The small noncongested stationary lesion which shows no tendency to progress over a period of years does not demand surgery.

An advancing pterygium is usually remediable as long as it is recognized and treated by surgery. In contrast, the progressive lesion which is not treated may lead to severe complications as shown by Fritz,[1] who reported a case of blindness resulting from neglected bilateral multiple pterygia.

During the five-year period from July 1, 1954, to July 1, 1959, 386 operations for pterygia were performed upon 280 individuals at the United States Public Health Service Hospital, Staten Island, New York; 213 of these patients, upon whom 298 operations were performed, were followed for six months or longer after surgery. A review of the medical records of these 213 persons supplied sufficient data and information to permit an evaluation and comparison of the various surgical procedures used in an attempt to determine which method or methods resulted in the least number of recurrences.

The purpose of this paper is to report the results of the different surgical procedures used, as well as to discuss various modifications of technique as to their relative merit. The particular surgical technique for the pterygium which I have found effective is described. In addition, several observations which were noted during this study are commented upon.

II. Statistical information

A. Data

Of the individuals followed in this study, 95 percent were seamen, while the remaining five percent were military personnel or their dependents.

Some general statistics of the 213 cases which had adequate follow-up examinations are shown in Table 1 which gives a statistical compilation relative to race, age, eye involved, and site of lesion. Using the various procedures shown in Table 2, 220 operations for primary pterygia were performed.

A comparison of the results of various operative procedures used for primary and recurrent pterygia in individuals of different racial backgrounds is shown in Table 3. Table 4 shows the various procedures performed in 78 operations for recurrent pterygia.

B. Comments

Interesting features of Table 1 show that (1) a high incidence of pterygia occurs in

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TABLE 1

GENERAL STATISTICS FOR 298 OPERATIONS FOR PTERYGIA PERFORMED UPON 213 INDIVIDUALS

Race	Puerto Rican	96
	Latin American	40
	Negro	30
	Caucasian	39
	Chinese	8
Age	Oldest	64
	Youngest	22
	Average	41
Eye involved	Left	139
	Right	117
	Both	21
Site	Nasal	284
	Temporal	14

individuals with a Puerto Rican or Latin American racial background,* (2) most pterygia tend to develop during middle age, (3) the majority of growths occur unilaterally rather than bilaterally, and (4) these lesions tend to be situated nasally more frequently than temporally.

Tables 2 and 4 indicate a lower recurrence rate whenever the additional features of cautery of the limbus and limbic groove are utilized. It is interesting to note that two of the recurrences following Procedure 6 of Table 2, as well as the two recurrences developing after Procedure 5 of Table 4, were observed in the same individual—a Chinese seaman who had large, fleshy, vascular lesions of both eyes which promptly recurred following transplantation. Both of the recurrent pterygia were excised and beta radiation given, but to no avail, as both growths rapidly recurred again. Mucous membrane grafting is now being considered in this particular case of resistant pterygia.

In Table 3, the cases of groups *A* and *C* show a higher recurrence rate than in groups *B* and *D*, in which cautery of the limbus and limbic groove are additional features. Table 3 also shows most of the recurrences in groups *A* and *C* to be in dark-skinned individuals. Correlated with this fact was the observation that the majority of pterygia in this study which were described as large, fleshy, and quite vascular occurred in the dark-skinned. Few such lesions were similarly observed in light-skinned individuals.

The recurrence rate is noted to decrease in groups *B* and *D* of Table 3, even in those individuals with a Puerto Rican, Latin American, or Negro racial background, in spite of the observation that many of the lesions in these people were quite fleshy and vascular. This reduced recurrence rate in groups *B* and *D* is assumed to be due to better control and prevention of revascularization of the operated site after surgery when cautery of the limbus and the limbic groove are used along with the modification of leaving an area of bare sclera at the limbus.

The data of Table 3 indicate fewer recurrences of pterygia, in light and dark-skinned individuals alike, whenever the features of bare sclera and cautery of the limbus, with or without the limbic groove, are used in combination with surgery.

III. SURGICAL TECHNIQUE

The surgical technique preferred and used by me for the pterygium is a transplantation modification. Although this technique can be used for nasally and temporally located lesions alike, the following procedure describes the method used when the pterygium is located nasally to the limbus.

The skin surrounding the eye is cleansed thoroughly with soap and water and painted

* A large number of patients, with either a Puerto Rican or South American racial background, are treated at this hospital. No actual data is available as to the racial distribution of all clinic and hospital admissions; however, it is felt that the increased incidence of pterygia in the Puerto Rican and South American racial groups is significant and does not parallel or reflect the distribution ratio of these two groups treated at this general hospital for various surgical and medical conditions.

TABLE 2

VARIOUS PROCEDURES PERFORMED FOR PRIMARY PTERYGIA AND RESULTS OBTAINED

Procedures Used	Number of Operations Performed	Number of Recurrences	Percentage of Recurrences
1. Excision alone	21	6	28.5
2. Transplantation alone	37	12	32.4
3. Excision plus bare sclera at limbus	4	1	25.0
4. Transplantation plus bare sclera at limbus	109	20	18.3
5. Excision, bare sclera at limbus and cautery of limbus	3	0	00.0
6. Transplantation, bare sclera at limbus, and cautery of limbus	39	3	07.7
7. Excision, bare sclera at limbus, cautery of limbus, and limbal groove	2	0	00.0
8. Transplantation, bare sclera at limbus cautery of limbus, and limbal groove	5	0	00.0

with tincture of Zephiran. The conjunctiva is anesthetized with drops of 0.5-percent pontocaine, and the eye is irrigated thoroughly with sterile water. A sterile operating drape sheet is placed over the eye.

An eye speculum is inserted; the eyelids are retracted, and 0.25 cc. of one-percent procaine with epinephrine is injected subconjunctivally beneath the body of the pterygium. This not only gives excellent local

TABLE 3

COMPARISON OF RECURRENCE RATES OF VARIOUS PROCEDURES FOR PRIMARY AND RECURRENT PTERYGIA IN REGARD TO DIFFERENT RACIAL BACKGROUNDS

			Racial Background			
			Puerto Rican and Latin American	Negro	Caucasian	Chinese
Primary Pterygia	Group *A*	Cases	83	30	19	6
		Recurrences	20	9	4	3
	Group *B*	Cases	24	10	5	2
		Recurrences	1	0	0	1
Recurrent Pterygia	Group *C*	Cases	33	11	5	3
		Recurrences	10	4	0	1
	Group *D*	Cases	14	4	1	1
		Recurrences	0	0	0	1

Group *A*. Includes all cases of primary pterygia done by Procedures 1 through 4 of Table 2.
Group *B*. Includes all cases of primary pterygia done by Procedures 5 though 8 of Table 2. (Additional features of cautery of the limbus and limbal groove performed upon these cases.)
Group *C*. Includes all cases of recurrent pterygia done by Procedures 1 through 4 of Table 4.
Group *D*. Includes all cases of recurrent pterygia done by Procedures 5 through 8 of Table 4. (Additional features of cautery of the limbus and limbal groove performed upon these cases.)

TABLE 4

VARIOUS PROCEDURES PERFORMED FOR RECURRENT PTERYGIA AND RESULTS OBTAINED

Procedure Used	Number of Operations Performed	Number of Recurrences	Percentage of Recurrences
1. Excision plus bare sclera at limbus	7	6	85.7
2. Transplantation plus bare sclera at limbus	2	1	50.0
3. Excision, bare sclera at limbus, and radiation	34	5	14.7
4. Transplantation, bare sclera at limbus, and radiation	12	3	25.0
5. Excision, bare sclera at limbus, cautery of limbus, and radiation	5	2	40.0
6. Transplantation, bare sclera at limbus, cautery of limbus, and radiation	7	0	00.0
7. Excision, bare sclera at limbus, cautery of limbus, limbal groove, and radiation	7	0	00.0
8. Transplantation, bare sclera at limbus, cautery of limbus, limbal groove, and radiation	4	0	00.0

anesthesia but dissects the conjunctiva and pterygium from the underlying tissue—in the absence of adhesions.

The head of the pterygium is then cleanly shaved from the cornea with a von Graefe knife (fig. 1). The initial incision should begin about one mm. in clear cornea central to the apex of the head of the pterygium. The neck of the pterygium is grasped and lifted gently with a pair of small forceps while the von Graefe knife severs the attachment of the head and neck from the underlying cornea. The corneal epithelium in this area may be removed also by such a maneuver, but this is of no consequence as the wound re-epithelizes itself readily. The pterygium is dissected free of the cornea up to the limbus. It is very important to remove all portions of pathologic tissue from the cornea. To achieve this, gentle scraping of the cornea with a No. 15 Bard-Parker blade may be required to remove adherent fragments of soft tissue.

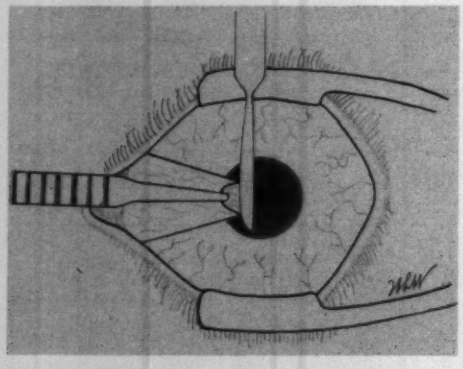

Fig. 1 (Walter). Forceps are shown lifting head of pterygium while a von Graefe knife severs its attachment from underlying cornea.

From the upper and lower edge of the pterygium at the limbus, incisions are made with scissors through the conjunctiva superiorly to the 12-o'clock position and inferiorly to the 6-o'clock position; such incisions separate the conjunctiva from its limbal attachment. A conjunctival incision is then made along the upper margin of the pterygium beginning at the limbus and extending the cut medially for six or seven mm. (fig. 2).

The pterygium body as well as the conjunctiva superior and inferior to the pterygium body is then dissected from the underlying subconjunctival tissue by using blunt

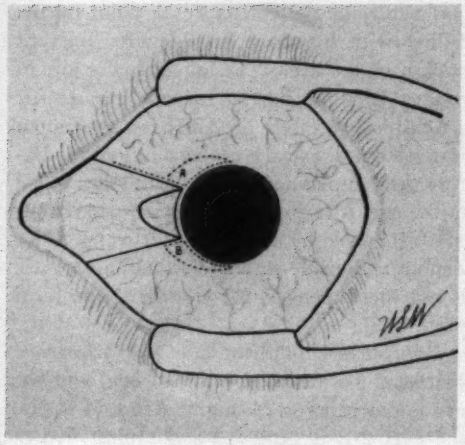

Fig. 2 (Walter). The dotted lines indicate the locations of the conjunctival incisions at the limbus and along the superior margin of the pterygium. The two triangular-shaped areas of conjunctiva (A and B) are excised.

dissection. In recurrent lesions, the conjunctiva may not be easily separated from the subconjunctival tissue due to adhesions, and sharp dissection with scissors may be required to accomplish this.

A partial peritomy is then performed by excising two small triangular shaped pieces of tissue from the limbal margins of the conjunctiva superior and inferior to the pterygium (fig. 2).

The subconjunctival tissue in the region of the pterygium at the limbus is then generously excised with scissors down to bare sclera (fig. 3). This should result in at least a three to four mm. margin of bare sclera at the limbus. All vessels in this bare area are lightly cauterized with a heated muscle hook.

At this point in the procedure, a limbal groove is made at the site of the pterygium, and this groove is further extended slightly above and below the actual limits of the pterygium at the limbus (fig. 4). Such a groove is made to extend approximately one third of the way through the thickness of this limbal area. I have found a blunt No. 5 Bard-Parker blade to be quite satisfactory

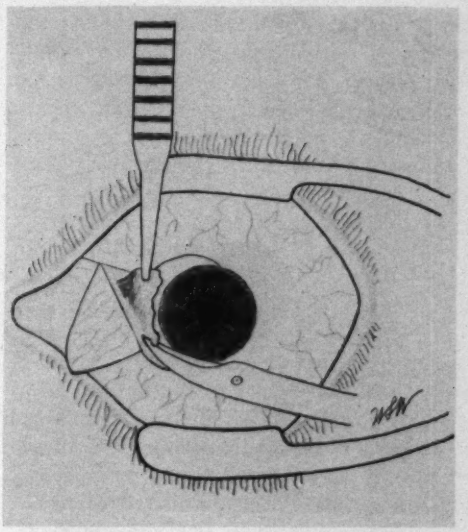

Fig. 3 (Walter). The subconjunctival tissue at the limbus is excised down to bare sclera with a pair of scissors.

in performing this procedure. The site of this limbic groove is then lightly cauterized throughout its entire length with a heated muscle hook.

The needles of a double-armed 6.0 chromic gut suture are then inserted from behind

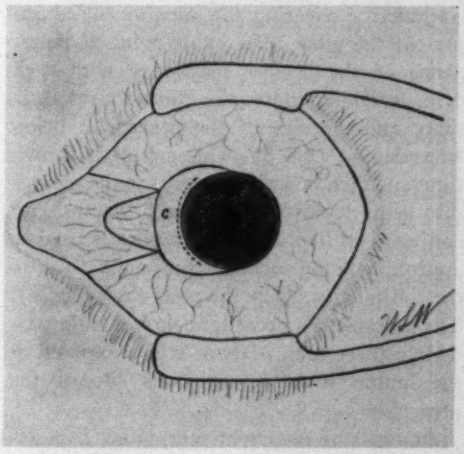

Fig. 4 (Walter). The dotted line at the limbus indicates the site where the limbal groove and cautery are performed. (C) Area of bare sclera.

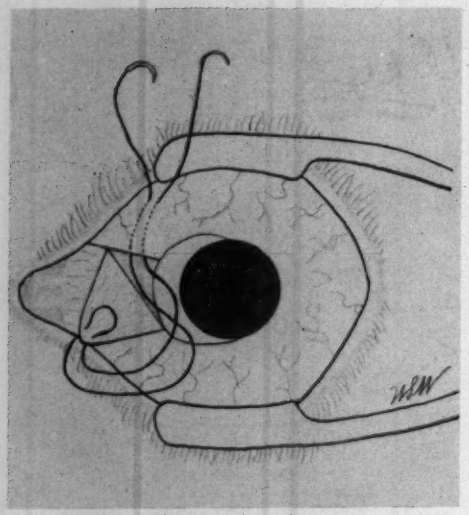

Fig. 5 (Walter). A double-armed 6-0 chromic gut suture is passed through the head of the pterygium, with the needles passing beneath the superior conjunctival flap and emerging through the bulbar conjunctiva in the region of the superior fornix.

forward through the head of the pterygium about two or three mm. apart. The suture loop is drawn tight and the needles are then directed posteriorly to the superior conjunctival flap and made to penetrate the bulbar conjunctiva covering the superior nasal aspect of the globe. The exact point of emergence of the needles may vary with each case depending upon the conjunctival elasticity and the size of the pterygium being transplanted (fig. 5). This suture is drawn tight and then tied which results in the pterygium being transplanted beneath the superior conjunctival flap. A second suture is used to approximate the superior conjunctival flap to the conjunctiva below the pterygium (fig. 6). The completed procedure leaves approximately three mm. of bare sclera exposed at the limbus over the previous site of the pterygium.

In cases of recurrent pterygium, beta radiation is administered at this point by applying the footplate of a strontium^{90} applicator to the limbus over the site of the pterygium while the patient fixates a point on the ceiling with his unoperated eye to prevent motion of the eyes. The applicator is left in contact with the limbus for one minute for a total dosage effect of 2,280 rep (roentgen equivalents physical) of beta radiation. Before the footplate of the applicator is applied to the eye, it is sterilized with 70-percent alcohol followed by a sterile water wash. Since Zephiran chloride corrodes aluminum, its use is not recommended for sterilizing the footplate.

Neosporin® ointment and hydrocortisone ointment are instilled into the eye, and the eye is patched for 24 hours. After 24 hours, the eyepatch is removed and topical hydrocortisone suspension is prescribed four times daily for three or four weeks.

I prefer to use the transplantation technique on all cases of primary pterygium, as well as on those cases of relatively thin recurrent pterygium. I use the excision technique in cases of recurrent pterygium in which the lesion is thickened and scarred, and in which I am unable to excise adequately the subconjunctival tissue to result in a thin structure for transplantation. The ex-

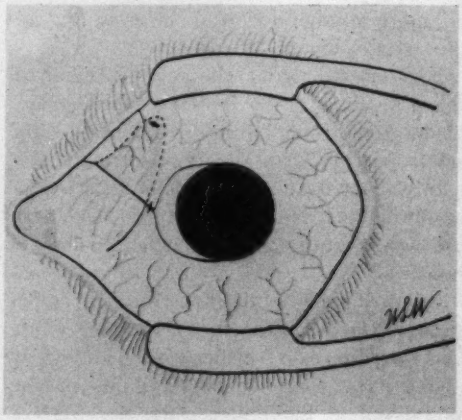

Fig. 6 (Walter). This view shows the completed operation, indicating the pterygium held in place by a tied suture. A second tied suture is shown attaching the superior conjunctival flap to the conjunctiva inferior to the pterygium. The area of bare sclera is shown at the limbus.

cision technique which I use is the method suggested by Escapini.[2]

Routinely, monocular pterygium surgery is done as an outpatient procedure; if both eyes are operated upon at the same time, the patient is admitted to the hospital.

IV. Discussion

A. Primary pterygia

The two basic techniques used in all the cases of primary pterygia studied were either excision or transplantation with certain additional modifications which will be discussed.

I do not feel that beta radiation should be used in cases of primary pterygia. Certain potential dangers can be associated with the use of such radiation, and therefore, this method should be reserved for treating only cases of recurrent pterygia.

1. Excision or transplantation technique alone leaving conjunctiva over the operated site at the limbus.

Table 2 shows that the recurrence rates following these two procedures were 28.5 percent and 32.4 percent respectfully. These recurrence rates were the highest of all methods used for primary pterygia which supports the observation of Doherty[3] that any technique which leaves tissue over the operated site at the limbus tends to lead to recurrences.

2. Bare sclera at the limbus.

The recurrence rate was observed to fall when either the excision or transplantation technique was augmented by excising the subconjunctival tissue over the site of the pterygium and leaving a bare area of sclera at the limbus (table 2). Why the diminished recurrence rate when this particular modification was utilized? To understand this better, the inflammatory theory, which has been proposed to explain the origin of the pterygium, should be mentioned.

It is well known that the exact etiology of the pterygium has been the subject of much debate among ophthalmologists. Numerous theories have been proposed to explain what causes its occurrence, but there has never been any general agreement on any one theory. To discuss these various theories is beyond the scope of this paper but I feel there should be brief mention of the interesting and plausible inflammatory theory of origin.

The inflammatory theory has a number of adherents, two of whom are Kamel[4] and Freide.[5] Kamel[6] considers the pterygium as a mechanical encroachment over the cornea of that part of the bulbar conjunctiva exposed in the palpebral fissure as a result of the shrinkage and contracture of . . . fibrous tissue bands laid down in the submucosa of the conjunctiva . . . in response to a chronic inflammatory keratoconjunctivitis. Infiltrates extend into the sublimbal region of the cornea from this area of episcleritis, and a certain portion of the adjoining conjunctiva is permitted to slide over the cornea due to its loose attachment to the underlying subconjunctival tissue at the limbus.

Sugar[7] has also stressed the importance of the subconjunctival tissue as a factor in the development of a pterygium. He feels that the subconjunctival tissue serves as a medium enabling the conjunctiva to slide over the cornea in the establishment of a pterygium.

By completely excising the subconjunctival tissue at the limbus over the site of the pterygium and permitting a bare area of sclera to exist between the conjunctiva and the limbus, the conjunctiva is allowed to become adherent to the underlying sclera, thus preventing its migration over the cornea and development of a recurrent lesion.

3. Cautery of the limbus.

Forty-two eyes received cautery of the limbus over the site of the lesion in addition to leaving an area of bare sclera (table 2). There were three recurrences indicating a decreased recurrence rate than in those eyes

upon which an excision or transplantation technique, with or without the bare sclera modification, was used.

Cautery of the limbus over the site of the pterygium serves to cauterize the blood vessels in this area, especially the capillaries, and this lessens the tendency of vascular invasion of this region after surgery. The prevention of vascularization at the limbus over the previous site of a pterygium is highly desired, for the recurrence rate is markedly increased when this area becomes vascularized following an operation.

4. *Limbal groove.*

The use of this modification is merely a further attempt to eradicate the blood vessels at the limbus over the operated site in order to prevent revascularization after surgery.

The limbal groove procedure not only severs the vessels in this area but may also result in scar tissue formation at the limbus which could possibly form some sort of barrier against vascular invasion of the cornea and recurrence of the pterygium at a later date.

Only seven cases, as shown in Table 2, have been done with this added feature, but the results have been most promising with no recurrences noted to date. Additional cases will have to be done for further evaluation.

B. Recurrent pterygia

In spite of surgical intervention, a number of pterygia may tend to recur. The treatment of recurrent pterygia by surgery has been aided considerably by the use of the strontium^{90} applicator. Since 1957 at this hospital, all recurrent pterygia have been treated by beta-ray therapy following surgery.

It is observed in Table 4 that the only additional feature in the treatment of recurrent pterygia, as opposed to the primary ones, has been the use of beta radiation. Those recurrent cases which had mucous membrane grafting were not included in this study.

Table 4 indicates diminishing recurrence rates as the features of bare sclera, cautery, and limbic groove are combined with beta radiation in the therapy of recurrent pterygia. All four of these features, alone or in combination with one another, have the effect of preventing or retarding revascularization of the operated site which is desired if the recurrence rate is to be kept at a minimum.

Whether the basic technique of excision or transplantation is used for the recurrent pterygium depends upon certain factors, the main one I believe is the finding of a thickened lesion in which the bulbar conjunctiva is not easily separated from the subconjunctival tissue due to marked adhesions which have matted the various tissues firmly together.

The majority of recurrent pterygia will exhibit some subconjunctival adhesions due to previous surgical intervention. I feel the excision technique is the procedure of choice in any case of recurrent pterygium in which it is not possible to separate adequately and remove a sufficient amount of the thickened subconjunctival tissue from the conjunctiva, as a poor cosmetic result is obtained whenever a bulky thick lesion is transplanted. As much as possible of the thickened subconjunctival tissue should be removed (by sharp dissection if necessary) when the lesion is excised so that an undesirable rim will not result.

The instrument used at this hospital for administering beta radiation to recurrent pterygia is a strontium^{90} applicator which has been calibrated to emit a surface dosage rate of 38 rep per second. Such an applicator produces no significant gamma radiation, and an adequate dose of beta radiation can be administered in a short time. Also at three mm. of depth, the dosage diminishes about 90 percent, so irradiation of the deeper ocular structures is at a minimum. Additional features of the applicator are the presence of a swivel attachment between the handle and the disc which permits adjustment of the applicator at any desirable angle, as well as a lucite shield which practically eliminates

radiation being received by the operator's hands (fig. 7).

Beta radiation is used to destroy the vascular channels at the operated site. The radiation of the strontium[90] applicator affects new blood vessels to a greater extent than old ones. Because the capillaries are more radiosensitive immediately after surgery, it is best to give an initial radiation dose immediately following the operation, as the capillaries can be obliterated with a lower dosage which results in less undesirable post-radiation reactions.

Beta radiation also has a biologic effect of preventing or retarding the overgrowth of tissue by depressing fibroblastic activity. The young developing fibroblasts present at the operated site shortly after surgery are just as radiosensitive as the newly forming blood vessels in this area. Therefore, beta radiation aids in retarding the formation of fibrous tissue at the operated site with the result of less scarring in this area.

All cases of recurrent pterygia which I treated were given 2,280 rep of beta radiation immediately following surgery, and this same dosage was repeated in one week if revascularization at the limbus was noted. No case in this study was given a total of more than 4,560 rep of radiation.

V. Miscellaneous observations

The majority of cases reviewed had preoperative descriptions of the pterygia. It was noted that whenever the initial lesions were described as thin and relatively avascular, few recurrences were observed regardless of the particular technique used.

On the contrary, those lesions which were large, fleshy, and vascular tended to be more stubborn and less amenable to surgical management, and recurrences were more common in this group. However, these recurrences were further minimized when the combined modifications of bare sclera, cautery, and limbic groove were utilized.

It was also noted that the recurrence rate tended to be somewhat higher in those eyes

Fig. 7 (Walter). Strontium[90] applicator used in treating recurrent pterygia.

in which the operated site remained congested longer than three to four weeks following surgery. The recurrence rate was much lower in those cases in which the operated site was white with minimal to no congestion within three to four weeks after surgery. This observation was in agreement with Escapini's[2] report in 1958.

Hydrocortisone suspension was used for three to four weeks following surgery in a portion of the cases. The use of the topical hydrocortisone seemed to whiten the eye more rapidly but certainly did not prevent recurrences. However, it probably did help in preventing or delaying the formation of excessive fibrous tissue at the operated site.

When the transplantation technique alone was used, leaving the body of the pterygium overlying the limbus, there seemed to be a somewhat greater tendency for the growth to recur again by assuming a horizontal direction following surgery.

When the pterygium was large, fleshy, vascular, and thickened, a cosmetically undesirable rim tended to result following an excision technique unless as much as possible of the thickened subconjunctival tissue was removed leaving the thinnest layer of conjunctiva possible. The same might be said

regarding the transplantation technique because, cosmetically, the appearance tended to be somewhat less desirable when a bulky, instead of a thin, pterygium was transplanted.

Whenever a transplantation technique was done, the cosmetic results were found to be more acceptable when the growth was transplanted superiorly rather than inferiorly, as the advantage of the masking effect of the upper eyelid was present.

Postradiation reactions such as burning, tearing, or itching were at a minimum in those cases of recurrent pterygium treated with postoperative beta radiation. To date, no evidence of radiation cataract or telangectasia of the conjunctiva has been noted. It may still be too early for these delayed reactions to have become apparent.

VI. Summary

All pterygia which show progression should have surgical intervention.

An evaluation and comparison of the surgical results of 298 operations for primary and recurrent pterygia in 213 individuals is presented. A statistical compilation of all cases relative to race, age, eye involved, and site of lesion is given, and the results of various procedures of pterygia surgery are compared.

Certain modifications of technique such as bare sclera at the limbus, cautery of the limbus, and limbal groove are discussed, and an attempt is made to evaluate the relative merits of these features when used in combination with surgery for pterygia. Such an evaluation suggests that the utilization of these modifications, either by themselves or in various combinations, tends to decrease the recurrence rate, and the use of all three features together further increases the chances of obtaining a permanent cure of pterygia. The reason for this better rate of cure is concluded to be due to a decreased incidence of revascularization at the operated site whenever these three features are used in combination with surgery.

The treatment of recurrent pterygia by surgery has been aided considerably by the use of beta radiation, which has the biologic effect of obliterating the small blood vessels at the limbus as well as depressing fibroblastic activity in this area. It is felt that beta radiation should not be used in cases of primary pterygia but should be reserved for treating recurrent lesions only. Beta radiation is an important factor in preventing revascularization of the operated site at the limbus in cases of stubborn recurrent pterygia.

A technique of surgery for pterygia is described. In addition, certain interesting observations noted during this study are commented upon.

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I wish to extend my appreciation to Mrs. Vera Mitchell and Mr. Kenneth Donohue for their helpful assistance in the preparation of this paper.

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EVALUATION OF THE WATER PROVOCATIVE TEST*

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While the water provocative test is frequently used as a tool for the diagnosis of early open-angle glaucoma, its mechanism of action is not universally agreed upon. Combinations of this test with other methods such as the water and pressor-congestion test[1] and water drinking and tonography,[2] have in no way clarified the picture.

As a possible explanation, Leydhecker,[3] Kronfeld,[4] Heegaard and Larsen,[5] Argawal and Sharma,[6] and others have related the rise in intraocular pressure in glaucomatous eyes to initial hemodilution following water consumption. In this regard, studies by Hertel,[7] Duke-Elder,[8] and Davson and Thomassen,[9] as well as clinical studies by Poos,[10] Dyar and Matthew,[11] Galin et al.,[12] and others have established that the eye, and particularly the glaucomatous eye, is a sensitive osmometer.

However, Schmidt,[13] Yonebayashi,[14] and others have reported that the response following water drinking is not initiated by induced hypo-osmolality.

Becker and Christienson,[2] Friedenwald,[15] Roberts,[16] and others have indicated that the ultimate path for the elevation of intraocular pressure after water may be through reduced facility of aqueous outflow. This latter consideration has been commented upon by Bárány,[17] and Roberts.[18] They have postulated that swelling of the trabecular area could increase the resistance to outflow.

DeRoetth,[19] as well as Scheie et al.,[20] however, have been unable to confirm the reduction in outflow facility in glaucomatous eyes following water ingestion, and have explained pressure increases as due to increments in flow. Furthermore, Becker and Gay[21] have noted that some cases of apparent decrease in outflow facility following water may be due to alterations in scleral rigidity.

Earlier studies attempting to evaluate hemodilution following water consumption in the human being have been relatively crude in light of presently available techniques. These have included serum conductivity measurements,[3] reductions in hemoglobin concentration,[6,22] determinations of hematocrit response,[5] and studies of blood water content.[14] Though detailed clinical studies[12] relating increased blood osmolality and intraocular pressure have recently appeared, few investigations using these techniques for the study of reduced blood osmolality and intraocular pressure have been carried out.

It is the purpose of this communication to report the blood osmolality changes, intraocular pressure variations, and tonographic alterations following water consumption by patients in the glaucomatous age group with no evidence of open-angle glaucoma.

MATERIALS AND METHODS

Patients were obtained from the eye clinic of the New York Hospital-Cornell Medical Center. All were past 55 years of age, and had no systemic diseases. These patients had been followed in the eye clinic for at least 10 years, and at no time were tensions greater than 20 mm. Hg recorded. Detailed ophthalmologic studies were carried out, and only those with entirely normal examinations were included in the control group. The knowledge of intraocular pressures for a long period, the presence of completely normal fields, and the absence of any ocular disorder on repeated examinations tend to validate the assumption that this group is free of open-angle glaucoma.

The patients were kept in a fasting state following their evening meal the day prior to

* From the Department of Surgery (Ophthalmology) of the New York Hospital-Cornell Medical Center. This study was aided in part by grants from The National Society for the Prevention of Blindness and The National Council to Combat Blindness.

TABLE 1

BLOOD OSMOLALITY IN MILLIOSMOLES BEFORE AND AT 15-MINUTE INTERVALS FOLLOWING THE RAPID INGESTION OF ONE LITER OF WATER IN 25 NORMAL PATIENTS

Subjects	Milliosmoles before Water	Reduction in Blood Osmolality (after min.)			
		15	30	45	60
1	286.2	−4.6	−7.5	−9.8	−5.4
2	294.3	−3.9	−8.8	−13.5	−11.6
3	289.0	−7.4	−8.4	−5.2	−16.2
4	281.0	+3.0	−5.0	−4.5	−8.0
5	289.5	−5.0	−12.2	−12.0	−11.9
6	284.0	−3.5	−3.0	−5.5	−8.0
7	288.2	−6.7	−9.7	−10.5	−6.7
8	284.0	−4.0	−3.8	−3.3	−6.7
9	295.0	−5.3	−9.8	−11.6	−14.2
10	286.2	−7.0	−7.5	−3.4	−14.0
11	291.0	−8.0	−5.5	−11.3	−9.3
12	290.2	−9.7	−12.4	−12.6	−15.7
13	292.2	−1.5	−8.7	−16.8	−4.7
14	287.0	−12.2	−11.4	−16.8	−15.7
15	289.8	−0.1	−5.1	−5.7	−10.3
16	288.0	−4.2	−6.7	−6.3	−9.7
17	284.6	−7.3	−6.7	−6.4	−6.8
18	296.0	−4.0	−8.3	−11.0	−7.0
19	296.0	−4.0	−8.3	−11.0	−7.0
20	293.7	−2.2	−4.2	−7.7	−5.7
21	292.2	−2.7	−2.7	−5.7	−4.5
22	295.3	−2.3	−8.0	−8.1	−7.2
23	283.5	−3.5	−5.2	−7.1	−3.5
24	282.0	−2.8	−4.5	−5.5	−5.3
25	292.0	−4.0	−8.0	−11.0	−11.5

the examination. In 25 cases, blood samples for subsequent analysis of freezing point depression utilizing a Fiske osmometer were obtained prior to rapid consumption of one liter of water, and at 15-minute intervals for one hour, thereafter.

In a group of 45 patients, tonography was performed on multiple occasions so that they became acclimated to the procedure. Applanation and multiple weight recordings with the Mueller electronic tonometer were recorded at all stages of the study, and calculations of ocular rigidity obtained. On the days of testing, blood samples were obtained for subsequent analysis of freezing point depression, tonography was performed, and one liter of water rapidly consumed. Subsequent blood samples were obtained and tonography was again performed approximately 40 minutes following water consumption.

Outflow facility was calculated utilizing Moses' and Becker's tables[23] based on Friedenwald's data.[24] When any change of ocular rigidity was noted, the data were recalculated to be comparable to those of average rigidity. Flow in cubic milliliters per minute was calculated by the equation $F = C(Po-Pv)$. No direct measurements of Pv (episcleral venous pressure) were obtained, and this value was assumed to be 11.7 mm.

RESULTS

Table 1 lists the results of blood osmolality determined in the group subjected to water drinking only. In only one of 100 samples was there a reading of increased milliosmoles following water drinking and in this case all subsequent samples indicated hemodilution. In virtually all cases, then, reduction of blood osmolality is obtained, and no evidence of hemocencentration or atypical hemodilution patterns obtained. This is contrary to data published by Schmidt[22] and Yonebayashi.[14]

Table 2 illustrates the frequency distribution of blood osmolality reduction with respect to time. Eighty-four percent of cases reached maximum hypo-osmolality at 45 minutes to one hour, with the greatest number (44 percent) achieving that level at the 45-minute sample. In only one case was a maximum change noted at the 15-minute sampling.

The data on alteration in blood osmolality in the group of 45 patients subjected to water drinking and tonography were essentially

TABLE 2

FREQUENCY DISTRIBUTION OF MAXIMUM BLOOD OSMOLALITY CHANGE IN MILLIOSMOLES WITH RESPECT TO TIME FOLLOWING THE RAPID INGESTION OF ONE LITER OF WATER IN 25 NORMAL PATIENTS

	Time Following Water Ingestion			
	15 min.	30 min.	45 min.	60 min.
Frequency	1/25	3/25	11/25	10/25
Percentage	4.0	12	44	40

similar to the information presented in Table 1, and will not be repeated. Figure 1 represents the intraocular pressure changes, measured at approximately 40 minutes, in this normal group following water ingestion. It should be noted that the distribution of values corresponds approximately to a normal curve. The range of pressure variation is from a decrease of 4.0 mm. to an increase of 5.0 mm., though the predominant effect is an increase in pressure. This increase is statistically significant at the one-percent level.

Figure 2 depicts the range of facility of aqueous outflow in the normal group before and after water consumption. Table 3 lists the specific data concerning intraocular pressure, outflow facility, aqueous flow, and Po/C before and after water drinking. It should be noted that approximately 60 percent of patients had a reduction in outflow facility, the remainder exhibiting either no change or an increase. No correlation between initial pressure and facility and ultimate pressure and facility could be statistically established. This degree of variability in a normal group is similar to that published by Swanljung and Blodi,[25] but varies from the data of Becker and Christienson.[2]

Analysis of this data with respect to aqueous flow tonographically computed, however, reveals that an increase in flow accounts for the predominant, though small, increase in intraocular pressure. Figure 3 relates the change in flow to the change in intraocular pressure, and the apparent correlation is obvious. Calculations reveal this correlation to be significant at the one-percent level.

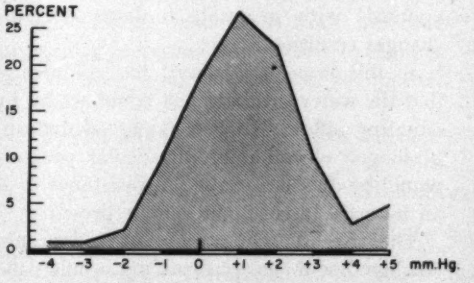

Fig. 1 (Galin, Aizawa and McLean). Percentage of patients exhibiting intraocular pressure changes 40 minutes following the rapid ingestion of one liter of water in a group of 45 normals.

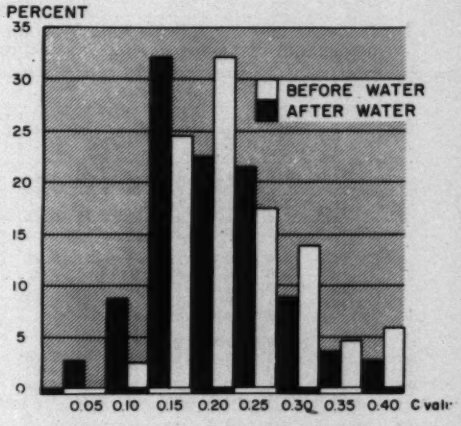

Fig. 2 (Galin, Aizawa and McLean). Facilities of aqueous outflow before and 40 minutes after the rapid ingestion of one liter of water in a group of 45 normal patients.

Calculations of ocular rigidity were made in all cases. However, though data with altered rigidity have been mathematically changed to be comparable to data with normal rigidity, no significant reproducible change in ocular rigidity was ascertainable.

Evaluation of the data with respect to Po/C is included in Table 3. Approximately five percent of this normal group had values greater than 100 before water, and 11 percent greater than 100 following water consumption. This data, too, is at variance with Becker and Christienson.[2]

Discussion

Water absorption from the gastro-intestinal tract is a rather complex process, and subject to a considerable amount of variation even in the same patient.[26-29] The data herein reported clearly indicate that hypoosmolality occurs following the ingestion of one liter of water.

Kinsey[30] has indicated, extrapolating rabbit data to man, that the reduction in blood

TABLE 3

INTRAOCULAR PRESSURE (Po), FACILITY OF AQUEOUS OUTFLOW (C), AQUEOUS FLOW (F), AND Po/C BEFORE AND AFTER THE RAPID INGESTION OF ONE LITER OF WATER IN 45 NORMAL PATIENTS*

	Right Eye									Left Eye								
	P_0	P_0'	ΔP	C	C′	F	F′	$\frac{P_0}{C}$	$\frac{P_0'}{C'}$	P_0	P_0'	ΔP	C	C′	F	F′	$\frac{P_0}{C}$	$\frac{P_0'}{C'}$
1	14.6	18.9	+4.3	.31	.42	0.90	3.02	−	−	15.9	15.2	−0.7	.32	.16	1.34	0.56	−	−
2	18.1	20.6	+2.1	.23	.24	1.47	2.14	−	−	13.4	17.3	+3.9	.20	.22	0.34	1.23	−	−
3	11.2	12.2	+1.0	.34	.27			−	−	9.8	13.4	+3.6	.26	.20			−	−
4	12.2	13.4	+1.2	.24	.20	0.12	0.34	−	−	14.6	14.6	0	.37	.28	1.07	0.81	−	−
5	10.2	10.2	0	.29	.19			−	−	7.8	8.9	−1.1	.19	.09			−	−
6	14.0	13.4	−0.6	.23	.25	0.53	0.43	−	−	11.2	14.0	+2.8	.29	.23			−	−
7	20.6	20.6	0	.30	.26	2.67	2.31	−	−	17.3	17.3	0	.22	.30	1.23	1.68	−	−
8	10.2	11.7	+1.5	.19	.15			−	−	10.7	10.2	−0.5	.19	.17			−	−
9	18.1	18.1	0	.15	.12	1.11	0.89	+	+	13.4	14.6	+1.2	.15	.11	0.26	0.32	−	+
10	9.4	12.8	+3.4	.19	.15			−	−	9.8	10.2	+0.4	.19	.11			−	−
11	10.7	11.7	+1.0	.27	.27			−	−	8.5	10.7	+2.2	.23	.17			−	−
12	15.9	18.1	+2.2	.35	.20	1.47	1.28	−	−	11.7	14.6	+2.9	.38	.25			−	−
13	13.4	15.2	+1.8	.25	.19	0.43	0.67	−	−	17.3	15.2	−2.1	.30	.19	1.68	0.67	−	−
14	17.3	16.6	+0.7	.36	.33	2.02	1.76	−	−	14.6	15.2	+0.6	.28	.21	0.81	0.74	−	−
15	14.6	18.1	+3.5	.25	.28	0.73	1.79	−	−	14.6	15.9	+1.3	.23	.19	0.67	0.80	−	−
16	8.5	9.8	+1.3	.23	.19			−	−	7.4	9.4	+2.0	.19	.15			−	−
17	17.3	18.1	+0.8	.27	.23	1.51	1.47	−	−	15.9	17.3	+1.4	.21	.17	0.88	1.18	−	+
18	12.8	15.9	+3.1	.18	.16	0.20	0.67	−	−	13.4	15.9	+2.5	.18	.14	0.31	0.59	−	+
19	14.6	14.6	0	.13	.13	0.38	0.38	+	+	13.4	15.9	+2.6	.15	.12	0.26	0.50	−	+
20	18.9	20.6	+1.7	.20	.16	1.44	1.42	−	+	14.0	14.6	+0.6	.20	.15	0.46	0.44	−	−
21	11.7	15.2	+3.5	.20	.29			−	−	11.7	12.8	+1.1	.32	.20			−	−
22	14.6	18.0	+3.4	.24	.27	0.70	1.70	−	−	14.0	15.3	+1.3	.23	.19	0.53	0.68	−	−
23	13.4	15.9	+2.5	.25	.26	0.43	1.09	−	−	15.3	16.6	+1.3	.26	.30	0.94	1.47	−	−
24	14.6	17.3	+2.7	.31	.25	0.90	1.40	−	−	13.4	15.2	+1.8	.23	.21	0.39	0.74	−	−
25	15.9	16.6	+0.7	.29	.25	1.22	1.23	−	−	13.4	12.1	+0.6	.18	.11	0.31	0.04	−	+
26	18.9	15.9	−3.0	.32	.21	2.30	0.88	−	−	15.2	14.6	−0.6	.21	.25	0.74	0.73	−	−
27	14.0	14.6	+0.6	.23	.23	0.53	0.67	−	−	11.2	14.0	+2.8	.24	.23			−	−
28	11.2	13.4	+2.2	.32	.30			−	−	11.7	12.2	+0.5	.32	.35			−	−
29	16.6	15.9	−0.7	.49	.35	2.40	1.47	−	−	15.2	13.4	−1.8	.50	.39	1.75	0.66	−	−
30	12.8	14.0	+1.2	.22	.28	0.24	0.64	−	−	10.2	11.7	+1.5	.24	.29			−	−
31	17.3	18.9	+1.6	.22	.20	1.23	1.44	−	−	14.6	17.3	+3.3	.18	.15	0.52	0.84	−	+
32	15.9	17.3	+1.4	.21	.22	0.88	1.23	—	—	13.4	12.8	−0.6	.13	.15	0.22	0.17	+	−
33	13.4	18.9	+5.5	.42	.42	0.71	3.02	−	−	18.1	14.6	−3.5	.48	.34	3.07	1.39	−	−
34	12.2	12.2	0.0	.32	.32	0.16	0.16	−	−	9.4	11.2	+1.8	>.39	>.45			−	−
35	15.9	18.9	+3.0	.26	.32	1.09	2.30	−	−	13.4	14.6	+1.2	.18	.18	0.31	0.52	−	−
36	7.5	12.8	+5.3	.17	.09			−	+	8.5	11.7	+3.2	.15	.15			−	−
37	11.7	12.2	+0.5	.24	.18			−	−	10.2	12.8	+2.6	.24	.20			−	−
38	13.4	12.2	−1.2	.42	.27	0.71	0.14	−	−	12.2	13.4	+1.2	.32	.28	0.16	0.48	−	−
39	15.9	21.5	+5.6	.16	.16	0.69	1.57	−	+	11.7	16.6	+4.7	.15	.17			−	−
40	9.4	10.2	+0.8	.28	.17			−	−	9.4	9.8	+0.4	.28	.19			−	−
41	20.6	25.5	+4.9	.24	.25	2.14	3.45	−	+	18.1	20.6	+2.5	.20	.27	1.28	2.40	−	−
42	14.6	12.2	+2.4	.23	.15	0.67	0.08	−	−	13.4	12.2	−1.2	.18		0.31		−	
43	18.9	21.5	+2.6	.23	.19	1.66	1.86	−	+	18.1	20.6	+2.5	.20	.24	1.28	2.14	−	−
44	20.6	20.6	0.0	.24	.21	2.14	1.87	−	−	19.7	18.9	−0.8	.27		0.22		−	
45	15.9	18.9	+3.0	.24	.30	1.01	2.16	−	−	13.2	14.4	+1.2	.17	.17			−	−

* Values of Po/C greater than 100 are indicated as +; those below 100 as −.

osmolality following ingestion of one liter of water would be about four millimoles. This figure is similar to our observed results and close to those theoretically obtainable if total body water is assumed to be in the range of 60 percent.

We may at least infer, therefore, that with respect to intraocular pressure the initiating sequence of events following water ingestion is related to a reduction in blood osmolality. Fluid will then enter the eye on the basis of the induced osmotic gradient. The eye with a significantly elevated pressure would be most sensitive to the slightest alteration in ocular volume[12] with moderate to large pressure changes resulting.

In this regard, Bárány[17] has commented that the water drinking test could act by facilitating inflow. He also has noted that any prolonged elevation of intraocular pressure would be due to a change in resistance or to an increase in resultant venous pressure.

The use of tonography, or tonography combined with water drinking, would label quite a few of these normal patients glaucomatous, if Becker and Christienson's criteria were followed.[2] Perhaps the variance of our data with theirs lies in the choice of con-

trol groups, as all of our patients were in the commonly accepted glaucomatous age range. The progressive decrease in outflow facility accompanying the aging process has been described by Becker.[31]

Detailed analysis of the data presented here discloses several major shortcomings in the application of "quantitative" tonography. First, we have little accurate data on the effect of rapid increase in total body water on the episcleral venous pressure. Duke-Elder[8] has demonstrated a prompt increase in venous pressure following the administration of hypotonic and even isosmotic solutions in animals. Second, all calculations of outflow facility assume the eye to be in a steady-state with the assumption that flow remains constant. It is apparent that after water drinking the eye is not in a steady-state, and that ocular volume increases. Only the fact that tonography is performed for just four minutes during which time major changes in flow probably do not occur permits a comparison of outflow facility before and after water. However, any comparison is not absolutely mathematically sound.

Last, the term, flow, is rather loosely used in these and other studies. Osmotic alterations may cause changes in aqueous flow, but certainly may alter ocular volume through changes in intravascular volume, as well as secretion. It has been noted that intraocular pressure reflects the pressure in several different vascular beds.[32] Until the effect of altered blood osmolality on these systems is known, there is insufficient basis to relate intraocular pressure change solely to changes in flow, even when outflow facility appears unaltered.

It should be apparent, then, that calculating outflow facility in an eye not in a steady-state, and flow using assumptions that have not been proved, leaves much to be desired.

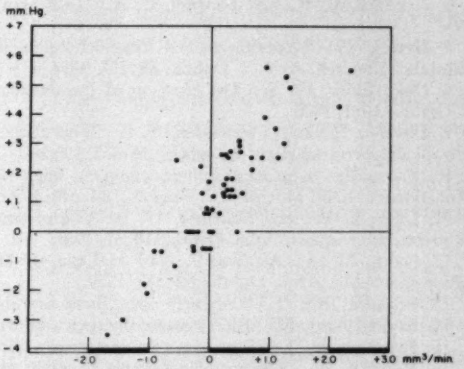

Fig. 3 (Galin, Aizawa and McLean). Relationship of inflow, tonographically computed, and intraocular pressure change following the rapid ingestion of one liter of water in 45 normal patients.

Summary

Following rapid ingestion of one liter of water, blood osmolality is reduced, the greatest reduction occurring at the 45- to 60-minute sample. In a nonglaucomatous group of patients in the glaucomatous age group, there is a statistically significant increase in aqueous "flow," tonographically calculated, accounting for an increase in intraocular pressure that is statistically significant, though small in magnitude after water drinking. This data would tend to indicate that the initiating sequence of events following water consumption is related to the osmotic gradient established. It would also tend to indicate theoretical errors in utilizing quantitative tonography following water ingestion.

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THERAPY OF RETINAL VEIN OCCLUSION

Use of fibrinolysin and anticoagulants

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Introduction

Although occlusion of the central retinal vein usually results in some visual loss, it has been brought out by many observers that any improvement of vision depends upon the type of condition present.

Klien and Olwin[1] described three mechanisms of branch or retinal vein obstruction:

(1) occlusion by external compression and secondary endothelial proliferation, (2) occlusion by primary venous diseases, either degenerative or inflammatory in nature, (3) occlusion by stagnation thrombosis.

Prognosis in untreated cases

Terminal visual acuity was usually poor according to Duke-Elder.[2] Duff, Falls, and Linman[3] in their survey of the literature found only a few reports in untreated cases. McLean[4] reported one out of 18 eyes achieved better than 20/200 vision. According to Moore[5] the end-result was unfavorable. Odquist[6] found useful visual acuity in 16 out of 36 cases. Braendstrup[7] reported useful vision in 20 percent of 131 cases. He believes that involvement of the macular area is important in determining the resultant visual acuity. Duff, Falls and Linman[3] in their follow-up of 79 untreated cases found 49 percent to have grown worse and secondary glaucoma developed in 43 percent. In 35 percent the condition was unchanged; in only 15 percent had it improved. Anderson and Vallotton[8] found six out of 45 cases improved. Summarizing these reports, in a total of 309 untreated cases, 61 showed some degree of improvement.

Previously used therapy

1. Vasodilators—Priscoline, niacin, acetycholine, and so forth—have not produced any effects similar to those obtained in arterial occlusion. Appelman and Lamotte,[9] however, believe the preferred treatment is with vasodilators, rutin, ascorbic acid and adrenochrome (Adrenoxyl).

2. The steroids alone have not been effective in this condition; as an adjunct they may be useful in reducing swelling of vascular walls due to inflammation.

At the present time there appears to be two methods of approach to the treatment of retinal vein occlusion: (1) prevention of formation of thrombi, and (2) lysis of already formed thrombi.

The first method is used when the disease has already manifested itself and prophylactic prevention of thrombotic episodes is attempted.

Table 1 suggests that in order to gain the objective of preventing thrombi formation one must interfere with stage I or stage II of blood coagulation. Interference with stage II by heparin (antithromboplastin) prevents the change of thromboplastin (prothrombin) to thrombin, clinically prolonging the clotting time of blood. It also has some unexplained softening effect upon the thrombus so affecting stage III. Bishydroxycoumarin and sodium warfarin are examples of anticoagulants that prevent formation of prothrombin in the liver. Therefore they act on stage II. Clinically they reduce the prothrombin time. Stage III interference, lysing the already formed clot, is produced by the proteolytic enzymes which include trypsin, chymotrypsin, kinase (streptokinase), papain and ficin. These will be discussed later along with a new fibrinolytic agent, plasmin.

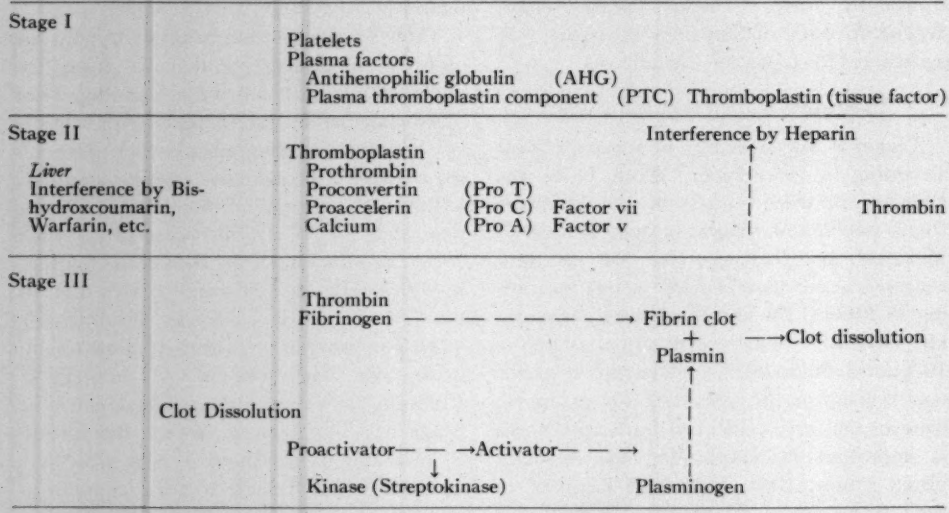
Review of therapy in retinal vein occlusion

Anticoagulant therapy has been employed in the treatment of occlusive vascular disease of the retina since 1937. A survey of world literature, including an evaluation of their own material, was made in 1951 by Duff, Falls and Linman.[3] After thrombosis of the central retinal vein (158 cases) 58 percent showed improvement; approximately 28 percent regained normal vision; 19 percent unchanged; 23 percent worsened and nine percent developed glaucoma. After thrombosis of tributary veins (102 cases) 61 percent improved; 29 percent regained normal vision; 20 percent unchanged; 19 percent worsened and two percent developed glaucoma. These authors concluded that a short term of intensive treatment with heparin seemed to produce results as favorable as those obtained with prolonged use of bishydroxycoumarin (Dicumarol®).

Anderson and Vallotton[8] used a combination of heparin and bishydroxycoumarin

TABLE 1

A HYPOTHETICAL SCHEME OF BLOOD COAGULATION



Monogram modified after J. H. Lewis, M.D., Department of Medicine, University of Pittsburgh, and M. J. Pohala, M.S., and H. O. Singher, Ph.D., Orth Research Foundation, Raritan, New Jersey.

(Dicumarol®) or ethyl biscoumocetate (Troxmexem®). Of 18 cases they found nine improved and noted that the results in the hypertensive-arteriosclerotic group were poor, whereas cases associated with infectious processes had a greater chance of restoration of function.

Klien[10] discussed the prognosis of venous occlusion treated with anticoagulants according to types of obstruction. She reported that local compression, allowing effective collateral pathways, offered the best prognosis under long-acting anticoagulants, particularly in incomplete occlusion. Prognosis is much less favorable in primary vascular disease than in cases of localized compression, since widespread venous disease may also affect the collaterals. In stagnation thrombosis, when the central vein pressure is lower than the intraocular pressure, a collapsed vein may occur. Minor organic alteration in the venal wall may then produce thrombosis formation. Klien concluded that short periods of anticoagulants may be as good as prolonged therapy in these cases.

Klien and Olwin[1] used heparin with various prothrombin depressants. Of 57 occlusions improvement was noted in 54 percent. They suggest that occlusions with a large element of stagnation in the pathogenesis should be treated with antispasmotics in addition to anticoagulants.

Barsky[11] advised both anticoagulants and steroid therapy. Vannas and Orma,[12] reporting on 75 occlusions, found general sclerotic manifestations either with or without hypertension in 65 percent of their cases, arterial hypertension in 71 percent, an inflammatory factor (usually sinusitis) in 13 percent, and simple glaucoma in 10 percent. They treated their cases first with anticoagulant therapy, preferably with heparin. Concomitant vasodilator therapy was employed, with specific treatment directed at any inflammatory conditions. In sclerotic cases, heparin and vitamin E, for months or years, were prescribed. Results in 37 treated cases and 36 untreated cases (in parentheses) were good in 59 percent (14 percent); fair in 20 percent (28 percent); poor in 13 percent (16 percent); and nil in eight percent (42 percent).

Mylius and Witt[13] obtained visual improvement in 75 patients treated with Thrombocid, a synthetic substance similar to heparin. In equal amounts the coagulation-retarding effect of Thrombocid is only one third to one half that of heparin, whereas its fibrinolytic action is greater than heparin. Like heparin, Thrombocid must be given parenterally. The coagulation-retarding effect begins early but lasts only three to five hours. The drug must, therefore, be administered intravenously three or four times daily for seven days. The dose on the first two days is 2.0 cc. four times daily and from the third through the seventh day 2.0 cc. three times daily. Thrombocid given on this schedule appeared safe and prothrombin time determinations were not necessary. Discontinuing treatment usually controls bleeding. In an emergency, intravenous injection of one-percent protamine sulfate will inactivate Thrombocid in a few minutes. However, there were other authors who found no improvement with the use of anticoagulants.[14-16]

Proteolytic enzyme therapy in vein occlusion

Retinal vein occlusion has purposely been omitted here because the following work was done on vein occlusion other than in the eye.

Probably the first fibrinolytic report to attract attention was on streptokinase, first demonstrated in the filtrates of beta hemolytic streptococcic cultures by Tillet and Garner[17] in 1933. It converts proactivator or profibrinolysin (plasminogen) to the activator.[18] Thus, when infused for the lysis of a clot, the action depends directly on the presence of adequate profibrinolysin in the patient's serum.

Unfortunately, a significant proportion of the population has had streptococcal infections, in which case streptokinase is an antigen, producing antistreptokinase in the plasma. This not only increases the risk of allergic reaction but also the inhibitor (antistreptokinase) must be used up before the streptokinase can begin to act in the fibrinolytic mechanism.[19-21] For this reason much more streptokinase is needed when it is used alone than when it is utilized to make preactivated fibrinolysin for direct fusion.[22] Good results in a few cases have been reported.[23] However, the most purified preparation of streptokinase now available still remains toxic and its use is unreliable.[24]

The enzyme, trypsin, transforms profibrinolysin to fibrinolysin; it can also lyse fibrin directly.[24,25] Its drawbacks are similar to those of streptokinase: the danger of foreign protein sensitization, inconsistent action due to inhibitors, lack of specificity and, in addition, an adverse effect on the coagulation process. These actions appear to make intravenous trypsin unsuitable for achieving acute dissolution of intravenous thrombi in man.[21,26,27]

Investigation with the use of trypsin, chymotrypsin, carboxypeptides, papain, fecin, varidase and plasmin showed only plasmin preparations to produce fibrinolytic activity in veins at less than toxic levels.[28]

When it became apparent that enzymes such as streptokinase and trypsin had limitations as thrombolytic agents, fibrinolysin (plasmin) itself was investigated for possible therapeutic use. This intrinsic fibrinolytic agent in the blood had been known before the turn of the century. Fibrinolysis normally occurs in the body; its usual function is to dissolve and remove small deposits of fibrin formed by minute injuries.[29] Only recently has satisfactory isolation from human and bovine plasma been obtained.

Profibrinolysin is obtained from the globulin factor of plasma. Small amounts of streptokinase activates profibrolysin to fibrinolysin which is subsequently released.[18,21,30] Unlike trypsin, fibrinolysin has a selective affinity for fibrin and attacks other plasma proteins to a lesser degree.[28,31] This is important in that the coagulation mechanism is not disturbed.[28] It has been shown that infusion of fibrinolysin will constantly dissolve arterial and venous thrombi experimently produced in animals.[28,32,33] Toxic effects are infrequent and minor. Clots present for less than three days disappear com-

pletely, while after the fifth day, clots do not change significantly.[28]

Side-effects of fibrinolysin

The most common abnormal reaction in patients was a temperature elevation which ranged from 1.0°F. to 5.2°F.,[21,22,28,34-36] usually starting six to eight hours after infusion and declining within the next 10 hours. Temperature elevation may occur much sooner.[37] Fever occurred more frequently in patients with active thrombosis.[21] Chills, dizziness, nausea, vomiting and various aches and pains have occurred.[21,22] In one series of 52 cases, allergic reactions developed in two—one characterized by erythema at the site of infusion and the second by generalized urticaria. Both patients responded promptly to treatment.[21] In this same series there were no significant effects upon blood coagulation, blood pressure or pulse rate. Two patients developed transient ECG changes near the temperature peak. There was transient (1+ to 2+) proteinura in 10 patients who had a febrile reaction. In follow-up periods from two weeks to eight months there was no delayed toxicity.[21]

Three cases of severe hypotension have been reported in which immediate intravenous pressor substances had to be used.[37-39] Two of these cases had associated allergic manifestations. One case[38] showed a high fever, hypotension, angioneurotic edema and mental confusion. However, in this case, an infusion of 200,000 units was given over a period of 15 minutes while the recommended time is not less than two and one-half hours.

Clinical results with use of plasmin

Moser,[40] reporting on 128 cases of various forms of thrombo-embolic disease, found plasmin treatment encouraging in 41 cases with deep venous thrombophlebitis. Some of these cases received anticoagulant therapy simultaneously or subsequently. Seven out of 13 cases of pulmonary embolism showed beneficial results. Two cases of coronary occlusion showed improvement. In 22 cases of cerebral thrombosis Moser had only limited comment because of the diagnostic and prognostic problems in this condition. Two cases showed improvement of ophthalmodynamometer values but clinical improvement occurred in only one patient. In 10 cases of acute occlusion of femoral and popliteal arteries, there was objective improvement when therapy was administered within 24 to 96 hours after onset. Moser believes larger doses are indicated in arterial occlusion.

Clifton[41] reported 76 cases of thrombosis or embolism in which excellent results were obtained in venous thrombosis. In a few cases good results were obtained with local therapy. Sussman and Fitch[42] found improvement in four out of nine cases of cerebral or carotid occlusion.

Harloe[43] found beneficial effects in two out of four cases of thrombophlebitis, in a case of peripheral arterial occlusion and also in a case of pulmonary infarction.

Sheffer and Israel,[44] reporting on 33 cases of pulmonary embolism and related conditions, state that fibrinolysin may be useful as a supplement to anticoagulant therapy. Stewart[45] found improvement in two cases of acute severe iliofemoral phlebitis. Roberts and Thompson[37] reported beneficial effects in three of six cases of acute thrombophlebitis.

In 82 cases of phlebothrombosis, Carroll[36] found an excellent response in 60 and a good response in 19 patients. Evans and Smedal[46] reported eight cases with thrombophlebitis of the arm after radical mastectomy and four patients with miscellaneous conditions and stated that fibrinolysin used within seven days after development of the condition offers promise in the lysis of venous thrombi.

Singher and Chapple[47] compiled data on 171 cases of phlebothrombosis and found excellent results in 65 percent, good in 26 percent, and poor in nine percent. On the other hand Villavicencio and Warren[34] reported marked clinical improvement in only one out of 22 patients with various thrombo-embolic conditions.

Fletcher, Alkjaersig, Sawyer and Sherry[48] reported on six patients suffering from diverse medical conditions of a chronic nature.

Each received a single infusion and the results yielded no evidence that fibrinolysin enhanced the clot-dissolving ability of the plasmin of these patients.

Since the literature here surveyed shows encouraging therapeutic results after infusion of fibrinolysin in several varieties of acute thrombo-embolic disease, it would seem justifiable to consider its use in the treatment of thrombo-embolic conditions of the eye. Clifton[22, 41] mentions two cases of central vein occlusion of one weeks' duration in which different doses of fibrinolysin were used. After therapy one case improved slightly; in the other there was no progression. In two cases of arterial occlusion the treatment was discontinued in one because of side-reactions and in the other because of no return of ocular function in spite of complete disappearance of arterial occlusion. Howden[49] reported the successful treatment of a case of central retinal vein thrombosis of two days' duration with fibrinolysin and the anticoagulant acenocoumarin (Sintrom®).

Case report

A 53-year-old man, when seen on July 6, 1959, gave a history of sudden loss of vision in his right eye of three days' duration.

Past history revealed a childhood injury to the left hip. Hypertension, discovered in 1958, was controlled with chlorothrozide and reserpine. Two acute episodes of bursitis in the elbow and patella were ascribed to an elevated blood uric acid in December, 1958.

General physical examination was normal except for shortening and atrophy of the left lower extremity.

Ocular examination revealed visual acuity to be: R.E., counting fingers at three ft.; L.E., 20/20. Right eye: external examination and media were normal. The fundus showed marked tortuosity and dilatation of all the veins emerging from the discs. One branch of the superior temporal vein was completely obstructed in an area of arterial crossing. There was moderate A-V nicking in other areas. Flame-shaped and round hemorrhages were present in the posterior pole. Left eye: external examination and media were normal. The veins were of approximately normal size, much smaller than in the opposite eye. Ocular tension (Schiøtz) was: R.E., 24.4 mm. Hg; L.E., 17.5 mm. Hg.

Diagnosis. (1) Occlusion of tributary and central retinal vein, right eye. (2) Retinal arteriolosclerosis, bilateral.

Laboratory. Routine urine and blood examinations were negative; cholesterol was 260 mg. percent.

Treatment was started with sodium heparin (200 mg. intravenously, twice daily). Fibrinolysin (50,000 units in 2.5-hr. infusions daily for three days), and sodium warfarin (Coumadin®) were started on the first day after the results of the prothrombin time were reported.

On the second day of treatment the patient's visual acuity was counting fingers at 12 feet; on the third day visual acuity was counting fingers at 16 feet; on the fourth day counting fingers at 20 feet. On the seventh day (first office visit after hospitalization) visual acuity was 20/20-2.

Heparin was discontinued after five days. The patient was stabilized on sodium warfarin (Coumadin®).

The present fundus picture in the right eye shows the retinal veins emerging from the disc to be approximately normal in size. There are no hemorrhages and only one small area of residue of edema near the disc. The previously completely obliterated tributary vein is now patent.

The only complicating effect of the fibrinolysin was a slight increase in temperature, the peak being 99.8°F. Temperature returned to and remained normal after the drug was discontinued.

Discussion

It seems logical to combine anticoagulant and fibrinolytic therapy in acute occlusive vascular diseases since each agent has shown an improvement in treated over untreated cases. These drugs have also demonstrated their ability to prevent further thrombosis formation and to dissolve existing thrombi. Evaluation of the fibrinolysin effect is difficult with the combined treatment.

Because of toxic manifestations, extreme caution in the administration of fibrinolysin is advisable. Toxic reactions are probably due to streptokinase impurities. An allergic history should be sought for and, if found, test doses followed by a waiting period must be employed. This procedure, as well as determination of fibrinolytic blood levels, is advisable before treatment is repeated. The simultaneous use of heparin for its clot softening and antithromboplastic effect and the use of an oral anticoagulant for long-term treatment would also be indicated.

Summary

1. Untreated retinal vein occlusion usually results in poor visual acuity.

2. Anticoagulants have been of benefit in

improving and preserving some vision.

3. A survey of the literature seems to indicate that fibrinolysin or related compounds might be promising agents for lysing acute thrombi.

4. A case of central retinal vein occlusion of three days' duration is reported. Excellent recovery resulted after the use of fibrinolysin and anticoagulants.

5. Suggested therapy is the use of fibrinolysin combined with anticoagulants and, when indicated, steroids and vasodilators. Foci of infection and any general systemic conditions that might in any way be related to the occlusion should be treated.

6. In view of the reported ineffectiveness in late thrombi and the occasional toxic manifestations, extreme caution and selectivity of cases is advised in use of lysing agents.

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PHOTIC DRIVING IN AMBLYOPIA EX ANOPSIA*

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Various alterations in response to flickering light have been described in amblyopia ex anopsia. It has been suggested that critical flicker frequency determination, photic driving, and central cortical time may be used as methods to evaluate amblyopia, and possibly to indicate the site or sites of origin. For example, changes in critical flicker frequency determination have been used as a subjective method in evaluating the optic conduction system.

A report by Lohmann[1] described a differ-

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ence in critical flicker frequency between the two eyes, with the amblyopic eye responding to a higher frequency of 46 per second in the central area, while the normal eye responded only to 34 per second. Teraskeli[2] has also observed that the central area in the amblyopic eye had a flicker frequency comparable to 10 degrees peripheral. These findings were confirmed by Miles[3] and Feinberg,[4] although the latter two authors differed in their results for normal individuals, and the methods used were not comparable.

Electro-encephalographic studies during exposure of the patient to a flashing light result in a change in brain wave frequencies to the rate of flicker. This phenomenon is known as photic driving. In general it will be found that the brain waves from the occipital cortex will tend to follow a flashing light at the rate of eight to 13 per second. This range of frequencies is known as the alpha range and is clearly seen when the patient is at rest with his eyes closed. Although photic driving occurs in almost all individuals,[5] it may be difficult to detect without the aid of an electronic analyzer as it is often obscured by other frequencies superimposed upon the responses.

Patients with amblyopia have been described by Burian and Watson[6] as having alterations in photic driving. In a series consisting of 65 normal subjects and 23 with amblyopia ex anopsia it was noted that photic driving was less easily produced in the amblyopic eye, and if present was of lower voltage and irregular in appearance. Often times the driving was combined with alpha rhythm. These findings were not observed by Parson-Smith,[7] Chinaglia and Balestrieri.[8]

The electro-encephalographic pattern of subjects with amblyopia have tended to indicate a higher percentage of deviant tracings with spikes, slow activity, and fast activity being described.[9–11] These findings are not characteristic per se for amblyopia.

In addition to photic driving, it has been observed by Monnier[12] that a response to a single flash of light may be obtained from the occipital cortex. Thus one may measure the electroretinogram and photic driving responses simultaneously. The duration of the electroretinogram was then subtracted from the total time and the remainder was called central cortical time. This method of investigation has been proposed by Burian and Watson[6] for studies of amblyopia, although no results were available.

More refined techniques have been developed to obtain consistency in photic driving. These involve a large area of stimulus so that the entire field is filled with light. The use of electronic analyzers for a detailed study of the electro-encephalogram has permitted discrete frequencies to be quantified for comparison of results. These summations, in turn, may be subjected to statistical analysis for reliability. Driving that was obscured by other frequencies would be recognized using this technique. The following report concerns the use of such an apparatus.

I. Method

Thirty-three children from the eye services of Washington University Clinics and St. Louis City Hospital, whose ages ranged from six to 14 years, were used. The visual acuity was 20/70 or less in the amblyopic eye, and no evidence of pathology was noted. All of the test group had strabismus. Sixteen nonamblyopic children were referred from the pediatric services for controls. An attempt was made to match the ages of the amblyopic group. Each child was examined in the EEG Research Laboratory of the Malcolm Bliss Mental Health Center, and both a standard resting electroencephalogram and response to intermittent photic stimulation were obtained.

The light source consisted of a 500-watt bulb in a movie projector. Interruption of the light source was produced by a disc episcotister which could be varied to produce from three to 33 interruptions per second. The illumination was projected on a 30 by 30-inch white flashed opal glass screen, and the subject was seated 12 inches behind this screen. The light intensity was normally 100

foot-candles, and the light-dark ratio throughout was one to one. Neutral density filters were introduced to obtain an illumination of 50 and 25 foot-candles.

A Gilson eight-channel electro-encephalograph was used, and scalp to scalp recordings were employed. Records were obtained from both the left and right parieto-occipital area, but only activity from the left side of the head was electronically analyzed for this study. The analyzer yielded a profile of the amount of activity at each of 24 frequencies within a 10-second interval. The pen deflection at each frequency was proportional to the average microvoltage multiplied by its duration during the 10-second period.

In the initial phase of the experiment 16 amblyopes and 10 nonamblyopic subjects participated. Photic stimulation was produced with both eyes open, right eye covered, and then left eye covered. In the second phase of the study, the intensity of the flickering light was varied as previously described. Twenty amblyopic and six nonamblyopic children participated. Because of an overlap in some procedures, the number of subjects in each determination varied.

Part 1. Specific EEG procedure

1. Eight artefact-free 10-second pages of eyes closed resting activity.
2. Six artefact-free pages of eyes open resting activity.
3. Photic driving survey (with both eyes open) consisting of a 40-second exposure with a 40-second interval between each exposure to each of the following frequencies: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13.5, 15, 18, 20, 22.
4. Photic driving survey with right eye covered (similar to No. 3).
5. Photic driving survey with left eye covered (similar to No. 3).

Part 2. Specific EEG procedure

1. Eight pages of eyes closed resting activity.
2. Six pages of eyes open resting activity.
3. Photic driving survey with light intensity of 100 foot-candles with right eye covered, consisting of 20-second exposure with a 20-second interval between each exposure to each of the following frequencies: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
4. Photic driving survey with light intensity of 50 foot-candles with right eye covered at the following frequencies: 4, 6, 9, 11.
5. Photic driving survey with light intensity of 25 foot-candles with right eye covered at the frequencies listed in No. 4.
6. The same photic driving procedures from No. 3 to No. 5 were then repeated with the left eye covered. A 20-second light on, off interval was used throughout Part 2.

The "resting eyes closed activity" was the average of six analyzed pages of artefact-free record. The "resting eyes open activity" was the average of four artefact free pages of analyzed activity. This was used as a baseline against which the effect of photic stimulation was evaluated. The amplitude of each discrete frequency in the "resting eyes open activity" was subtracted from that obtained by photic driving. In this study photic driving was defined as the amount of cortical activity present during photic stimulation minus the spontaneous activity recorded during eyes open resting period.

II. Results

A. Eyes closed resting activity

The eyes closed resting potentials are illustrated in Figure 1. Upon comparison of 16 normal subjects to 33 amblyopes, it was noted that both curves tend to be similar, with the maximum activity occurring in the range of 6.5 to 12 cycles per second. The slight increase seen in the alpha range (eight to 13 cycles per second) of the amblyopic group was not statistically significant.

B. Monocular photic driving

The similarity of driving response in the affected eye and nonaffected eye is illustrated by the two profiles in Figure 2. The curve for the affected eye tended to be higher than for the nonaffected eye, especially in the

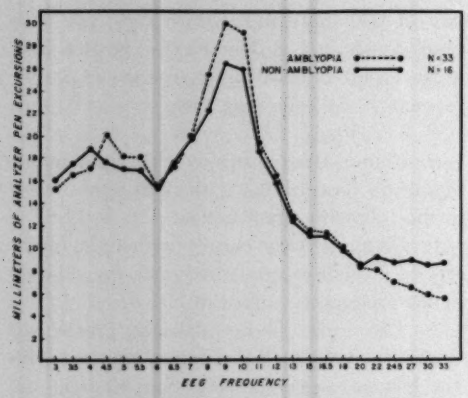

Fig. 1 (Miller, et al.). Eyes closed resting activity.

eight to 10 cycle per second range. However, this difference was not statistically reliable. In fact, only 16 subjects had more eight to 10 cycles per second in their affected eye, while 14 of the subjects had more eight to 10 cycles per second driving in their nonaffected eye.

Further evidence of the similarity in the two eyes was seen in the correlation of amount of driving between the affected and nonaffected eye. For driving in the three to seven cycles per second range, the rank order (Rho) correlation was 0.63, and for driving in the eight to 12 range it was 0.66. Both correlations were significant beyond the 0.001 level indicating that if a low or high amount of driving was seen in one eye, a similar driving response will most often be found in the other eye. The fact that the correlation was not nearer 1.0 indicates that the response in the two eyes was not always identical for all subjects.

When the driving response in the right eye was compared with driving in the left eye for the 16 nonamblyopic subjects, no significant difference was found. A further indication of the resemblance between the amblyopic and nonamblyopic group was the rank order correlation between the right and left eye in the normal group. The correlations of 0.63 for three to seven cycles per second driving and a 0.69 for eight to 12 cycles per second were almost identical to those found between the affected and nonaffected eyes in the amblyopic subjects.

C. Binocular photic driving

The results listed in Table 1 indicated that the amblyopic response was significantly greater in the three to seven cycles per second range and significantly less in the eight to 18 cycles per second range. The two groups did not differ in the 15 to 22 cycles per second range. The results are shown in Figure 3. The peak driving response for the amblyopic group was seven cycles per second, while the peak response for the nonamblyopic subjects was 11 cycles per second. The most striking difference in the two curves, however, was the marked decrease of the amblyopic driving responses in the eight to 13 cycles per second range. The nonamblyopic subjects had a constantly higher driving response over the eight to 13 cycles per second

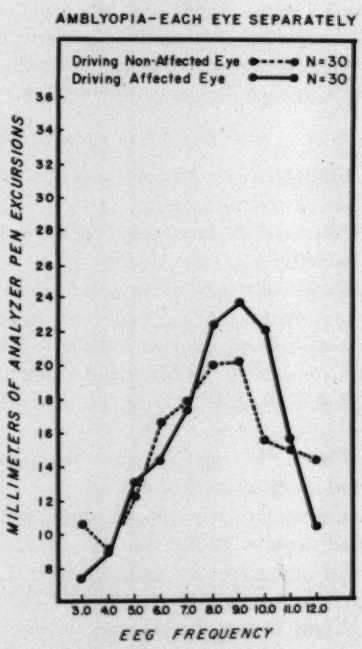

Fig. 2 (Miller, et al.). Comparison of photic driving from the amblyopic and nonamblyopic eye.

TABLE 1

PHOTIC DRIVING RESPONSE, BOTH EYES OPEN, FOR AMBLYOPIC AND NONAMBLYOPIC CHILDREN

Frequency (cps)		3–7		8–13		15–22		8–10		11–13	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Amblyopic	N = 16	124.1	54.8	112.9	46.1	38.2	23.3	69.6	37.9	44.3	21.0
Nonamblyopic	N = 10	83.5	31.7	160.6	49.3	49.5	16.3	84.1	41.7	79.9	27.5
	t	2.39*		2.46*		1.61		0.88		3.56†	

* Significant <0.05 level.
† Significant 0.01 level.

range, while the amblyopic subjects decreased within this area.

Dividing the eight to 13 cycles per second range into eight to 10 and 11 to 13 cycles per second, and comparing the two groups of subjects, revealed the difference in driving response. The mean and standard deviation values are also listed in Table 1. The mean values for the two groups reflected the curves of Figure 3 and indicated the decrease in driving response for the amblyopic group. The difference in driving response between the amblyopic and nonamblyopic subjects in the 11 to 13 cycles per second range would be expected by chance only one time out of a hundred.

These results indicated that the pattern of driving was different between the amblyopic and nonamblyopic patients. The amblyopic subjects drove more in the slower frequencies below eight cycles per second, while the nonamblyopic patients responded more in the alpha range and this difference was present only under binocular conditions.

D. Effect of light intensity on photic driving

The response for 100, 50, and 25 foot-candles of the affected and nonaffected eyes in amblyopic subjects are presented in Figure 4. The resemblance of the driving profiles of both affected and nonaffected eyes indicated that there was no relationship between driving and light intensity. Comparison of the curves for the affected and nonaffected eyes suggested that the driving response in the affected eyes was greater than the nonaffected eyes. However, statistical

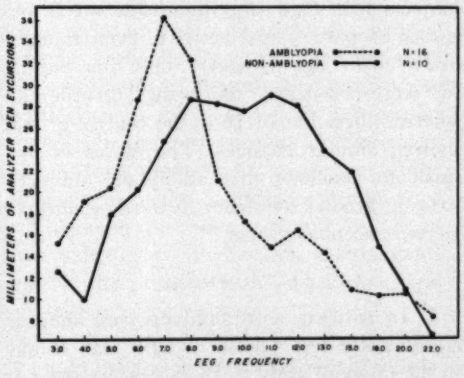

Fig. 3 (Miller, et al.). Results from driving both eyes simultaneously in subjects with and without amblyopia.

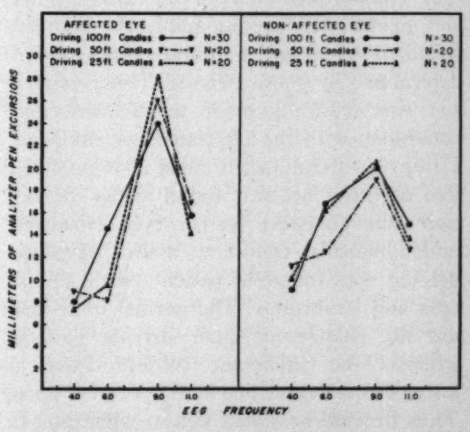

Fig. 4 (Miller, et al.). Responses from the (left) affected and (right) nonaffected eye under reduced illumination.

analysis again indicated that these differences could occur by chance.

E. Comparison of the basic EEG

Clinical comparison of the electro-encephalographic records of the two groups indicated no statistical difference in the degree of disorganization, though the amblyopic group did have a larger number of subjects who demonstrated high amplitude slow waves or bursts of paroxysmal activity. Three (18.7 percent) of the 16 nonamblyopic subjects and nine (27.3 percent) of the amblyopic subjects were classified as being disordered for age. One nonamblyopic subject and three amblyopic subjects were categorized as having borderline disorder for age. Statistical tests indicated that this could arise 30 times out of 100 by chance.

Examination of the analyzer scores for the subjects classified as disordered for age indicated that all had more analyzed activity in the three to seven cycles per second range than did those classified as having normal activity. These results also supported previous findings that evaluation of analyzed electro-encephalographic activity and clinical examination produce similar results.

III. Discussion

A comparison between the affected eye and nonaffected eye in amblyopic subjects failed to reveal any significant difference as determined by photic driving. This comparison was naturally made under monocular conditions with the nontested eye occluded. Using this technique, it could also be stated that no difference was found in the conduction system between the two eyes. However, under binocular conditions a shift of photic driving was found in patients with amblyopia and strabismus. The normal individual did not change his basic driving pattern, whereas the amblyopic subject drove at lower frequencies when both eyes were open. Thus it could be stated that an alteration in the response of the occipital cortex was seen under a binocular situation. (These determinations cannot be used to state definitely the location of amblyopia. They do, however, show that changes occur in the occipital region under binocular conditions). The tendency to respond to flashes of light at lower frequencies also was unusual.

This finding was not previously noted by Parson-Smith, Chinaglia, and Balestrieri. Most probably this was due to the conditions of their determinations since driving was obtained with eyes closed and the nontested eye was bandaged. Naturally binocularity would be lacking under this situation.

One problem that was not resolved was the possibility that these findings may be a manifestation of suppression since all of the test subjects had strabismus as well as amblyopia ex anopsia. Further studies are being conducted in a series of alternators in an effort to establish this.

While the greater response obtained from the amblyopic eye at lower light intensities was not significant, the direction of the differences again highlighted the finding that the affected eye was as responsive to photic stimulation as the nonaffected eye. This suggested that other explanations must be sought to explain the differences in visual acuity besides a loss of gross photic response.

A clinical comparison indicated that the amblyopic group had a larger number of subjects with high amplitude slow waves or bursts of paroxysmal activity, even though corrected for age. However, only nine out of 33 were classified as being disordered, whereas three out of 16 in the control group showed similar changes. The series is too small to conclude that amblyopic subjects have a greater tendency toward abnormal electro-encephalograms.

IV. Summary

1. In patients with amblyopia ex anopsia significantly less photic driving was found in the range of eight to 18 flashes per second, and greater in the three to seven area under binocular conditions.

2. The nonamblyopic subjects responded greatest in the eight to 13 flashes per second range with both eyes open.

3. No difference in photic driving was found testing the amblyopic and nonamblyopic eye separately.

4. Decreasing the light intensity did not influence the response from the amblyopic or nonamblyopic eye.

5. There was no significant difference in the clinical evaluation of the electroencaphalograms in the amblyopic and nonamblyopic groups.

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THE CO-OPERATION OF EXTRAOCULAR MUSCLES

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The best experimental basis for studying analytically the action of extraocular muscles has been given by A. W. Volkmann[1] who, by means of careful and painstaking measurements on 30 heads, determined the average co-ordinates of the effective origins and the effective insertions of the six extraocular muscles. His findings (in mm.) presented in Table 1, form the basis of the present study.

The origin of the co-ordinate system used by Volkmann coincides with the center of rotation of the eye; the positive x-axis points outward, the positive y-axis backward, and the positive z-axis upward.

With the aid of these co-ordinates, one can study the action of an individual muscle as follows:

The three points, (1) the center of rotation of the eye, (2) the effective origin of the muscle, and (3) the effective insertion of the muscle, determine its muscle plane, and the perpendicular to this plane through the center of rotation is its axis of rotation.

Volkmann's co-ordinates of the muscle insertions refer to the primary position. For any other position of the eye, these co-ordinates assume different values because the insertions participate, of course, in the eye's rotation to the position in question. This means that there is a different set of muscle planes and axes of rotation for every position of the eye. However, the participation of the effective insertions in the eye's rotation is not complete. The effective insertions resist, so to speak, being rotated out of their primary muscle planes. This was observed

TABLE 1

THE FINDINGS OF VOLKMANN

Muscle	Origin			Insertion		
	x	y	z	x	y	z
Superior rectus	−16.00	+31.76	+ 3.60	0.00	−7.63	+10.48
Inferior rectus	−16.00	+31.76	− 2.40	0.00	−8.02	−10.24
Lateral rectus	−13.00	+34.00	+ 0.60	+10.08	−6.50	0.00
Medial rectus	−17.00	+30.00	+ 0.60	− 9.65	−8.84	0.00
Superior oblique	−15.27	− 8.24	+12.25	+ 2.90	+4.41	+11.05
Inferior oblique	−11.10	−11.34	−15.46	+ 8.70	+7.18	0.00

by Helmholtz[2] who stated, "It is to be noted that all ocular muscles have a rather broad insertion with fibers fanning out a little. The consequence is that even if the eye has rotated considerably from the primary position, the axes of rotation of the individual muscles do not significantly change their positions in space." He explains that when the eye turns, say in or out, the effective insertions of the elevators and the depressors shift, "as one can easily see on preparations of the eyeball," from the middle of their broad insertions to the more extended part. This restricts the displacements of the effective insertions and, consequently, also the displacements of the muscle planes and the corresponding axes of rotation.

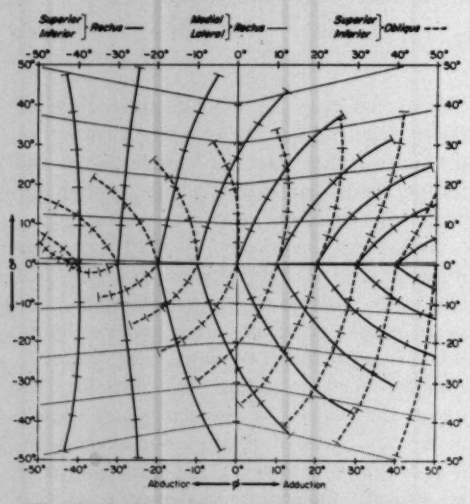

Fig. 1 (Boeder). Traces of the line of fixation on a sphere concentric with the eye when the vertical muscles act individually from positions of adduction or abduction and the horizontal muscles from positions of elevation or depression.

An estimate of the degree of participation of the effective insertions in ocular rotations can be derived from Fink's study[3] of muscle insertions. On the basis of his findings for the lengths of insertions, it seems safe to assume that in extreme cases, which occur for the horizontal recti in vertical rotations and for the vertical muscles in horizontal rotations, this participation ranges from 35 to 70 percent of the eye's rotation, the actual amount depending on the muscle in question.

When the axis of rotation has thus been determined for an individual muscle and a given starting position of the eye, the muscle is allowed to act, that is, to rotate the eye, and this action can be characterized by the trace which the line of fixation would make on a sphere concentric with the eye.

On the sphere we shall use spherical coordinates φ, ϑ, measuring horizontal and vertical rotations respectively. For the primary position we choose $\varphi = 0$, $\vartheta = 0$, and adductions as well as elevations shall be regarded as positive.

Figure 1 shows the traces which the line of fixation would make on the sphere if the horizontal recti acted individually and the eye were initially in the primary position or in positions of elevation and depression. It also shows the traces which the line of fixation would make if the elevators and depressors acted individually and the eye were initially in the primary position or in positions of adduction or abduction. The curves in Figure 1 refer to the right eye if we imag-

ine ourselves viewing them from the outside of the sphere; they refer to the left eye if we imagine ourselves viewing them from the inside of the sphere. Each complete curve represents a rotation of 50 degrees about the respective axes of rotation; the small cross lines indicate the cycloduction of the eye (with respect to objective verticals) at every 10 degrees of rotation.

The action of an individual muscle is usually characterized by its contributions to adduction or abduction, to elevation or depression, and to incycloduction or excycloduction. The curves of Figure 1 enable us to estimate these component actions of all muscles at any phase of their respective rotations. It is readily seen that the character of the muscle action may change as the rotation from a given starting position continues. This is especially true for the inferior oblique. From initial positions of adduction, the inferior oblique starts, as Krewson[4] has shown, as a partial adductor; however, as the rotations continue, this adduction diminishes and, except for starting positions of pronounced adduction, actually turns into abduction. It would be erroneous, therefore, to judge the total action of a muscle on the basis of a vector analysis which can reveal only the muscle's behavior in the vicinity of the starting position.

Muscle pairs

The study of the action of a single muscle independent of the other five is, of course, highly hypothetical because normally any rotation of the eye displaces the insertions of all muscles with the result that their states of contraction also change. Most directly involved is the antagonist which, generally, has to extend* when its opposite muscle contracts.

From a mechanical point of view, extension must be regarded as a muscle action quite on par with contraction. Seen in isolation, it has its own muscle plane and its own axis of rotation, namely those of the antagonist. When a muscle contracts and its antagonist extends, the resulting rotation will be about an axis that is neither the axis of the contracting muscle nor that of the extending muscle but, we shall assume, an axis midway between the two. This important assumption reduces the number of theoretically independently acting muscles from six to three muscle pairs, each having its own axis of rotation.

The action of a muscle pair for a given initial position of the eye is revealed when its axis of rotation corresponding to this position is known. This axis is found by locating the effective insertions of the two muscles of a pair for the given initial position and by determining the corresponding muscle planes and the axes of rotation. The axis midway between the two axes of rotation is the common axis of the muscle pair for the particular position of the eye.

Vertical rectus pair

Let this method first be applied to the pair of vertical recti. For the primary position, the axis poles for the superior and inferior recti are found respectively at $\varphi = 65°$, $\vartheta = -17°$, and $\varphi = 64.5°$, $\vartheta = +18°$, and therefore the common axis of the pair is very close to $\varphi = 65°$, $\vartheta = 0$. For positions of adduction and abduction, the axis poles of the individual muscles change as indicated in Figure 2, and consequently the axis midway between any corresponding axes, that is, the common axis of the muscle pair, remains fixed; it is invariant in adduction and abduction. This means that no matter which position of adduction or abduction the line of fixation may initially assume, the vertical rectus pair, if it could act alone, would rotate the eye about the axis located at $\varphi = 65°$ in the horizontal plane (fig. 6).

This is true if one muscle of the pair contracts while the other extends. In case both muscles of the pair contract with equal effectiveness, the common axis of the pair shifts

* The terms "extend" and "extension" are used here without any physiologic connotation; they merely refer to increased length of muscles.

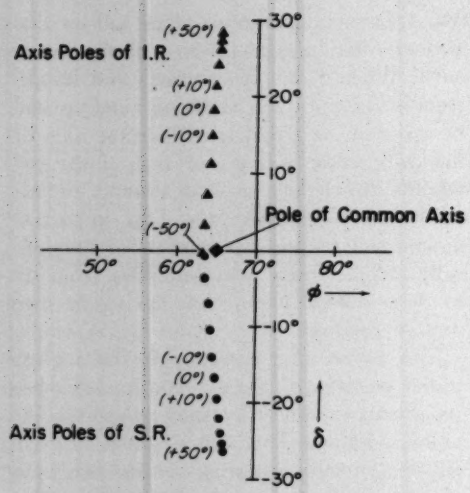

Fig. 2 (Boeder). Location of axis poles of superior and inferior recti. The degrees along the poles indicate the corresponding positions of the eye: adduction, 0° to +50°; abduction, 0° to −50°.

90 degrees; it remains in the plane containing the axes of the two individual muscles but is perpendicular to the common axis of the contracting-extending muscle pair (fig. 3). In the present case, this means that the co-contracting vertical rectus pair has a nearly precise vertical axis and therefore could act as a pure adductor. Since smooth motility would seem to require that co-contraction and contraction-extension be superposable in different ratios, the vertical rectus pair can, theoretically, rotate the eye not only about the 65-degree axis in the horizontal plane, or the vertical axis, but about any axis located between the two; however, with the limitation that for any position of the eye along the horizontal meridian, co-contraction would produce adduction, never abduction.

This potential combination of vertical and horizontal action is possible only because the axes of the individual muscles form an angle with each other. If their axes coincided in the horizontal plane, contraction of both muscles could not produce adduction but would pull the eye toward the muscles' origins.

In rotations, the torque is defined as force x radius. Figure 3 shows that r_{c-c}, the radius for the co-contracting muscle pair is r sin ω, where r is the radius of the globe and ω is half the angle between the axes of the superior and the inferior rectus. We shall put the forces of the muscles proportional to their average cross sections as determined by Volkmann[1]: SR 11.34, IR 15.85, MR 17.39, LR 16.73, SO 8.36, IO 7.89 mm.[2] It follows that the ratio of the torque of the adducting vertical rectus pair to that of the medial rectus is 1.56 sin ω.

According to Figure 2, $\omega = 0$ at $\varphi = -50°$; $\omega = 17.5°$ at the primary position ($\varphi = 0$); $\omega = 25°$ at $\varphi = +30°$, and $\omega = 27°$ at $\varphi = +50°$. Since the muscles are said to have their normal tonus in the primary position and contraction and extension are regarded as deviations from this normal state, the potential adducting power of the vertical rectus pair starts at the primary position where its torque, according to the above, is about 47 percent of that of the medial rectus and then increases, as the eye adducts, to about 66 percent at $\varphi = 30°$ and to 71 percent at $\varphi = +50°$. In abduction, however, both muscles of the pair must extend, in fact, without such co-extension, there could be no abduction of the eye. When the eye returns from a position of abduction,

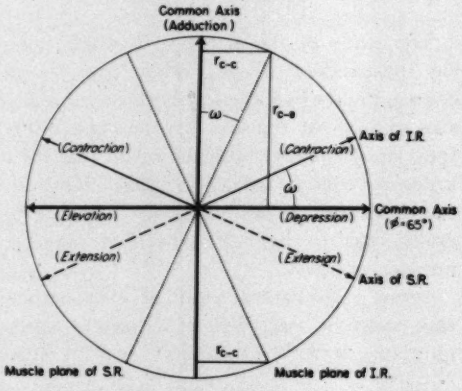

Fig. 3 (Boeder). The two principal axes of rotation of the vertical rectus pair and their radii of torque.

say, $\varphi = -50°$, to the primary position, the necessary co-contraction could help in adducting the eye with a torque that increases from 0 to 47 percent of that of the medial rectus.

The question as to what extent the co-contracting vertical rectus pair actually helps the medial rectus in adducting the eye in the normal act of seeing cannot be answered by this analysis. Electromyography has so far failed to show a clear-cut increase in the activity of this muscle pair in adduction.[5] Nevertheless, both muscles of the pair will have to contract simultaneously in order to be ready for any subsequent or simultaneous action of elevation or depression. (See the indicated co-contraction in adduction in Figure 9.) However, whether the co-contraction will merely take up the slack or actively help in adducting the eye is an open question, though it seems that, at least in extreme adduction, the medial rectus is in need of such help.[6] Although strong, its arc of contact is only about 30 degrees. Consequently, as adduction passes the 30-degree mark, its action would have an increasing retractive component, whereas the torque of the adducting vertical rectus pair would increase with increasing adduction.

Figure 3 also shows that r_{c-e}, the radius for the contracting-extending muscle pair varies with the cosine of ω. If $\omega = 0$, the torque is maximal; as ω increases, the torque decreases. Thus, the torque of the contracting-extending vertical rectus pair is 100% at $\varphi = -50°$, then decreases to 95% at the primary position and to 89 percent at $\varphi = +50°$.

Oblique muscle pair

For the primary position, the axis poles of the superior and inferior obliques are found, respectively, at $\varphi = -35.5°$, $\vartheta = +10°$, and $\varphi = -39.5$, $\vartheta = +6°$, and therefore the common axis of the pair does not lie in the horizontal plane but has its pole at $\varphi = -37.5°$, $\vartheta = +8°$.

For the positions of adduction and abduction, the axis pole of the individual muscles

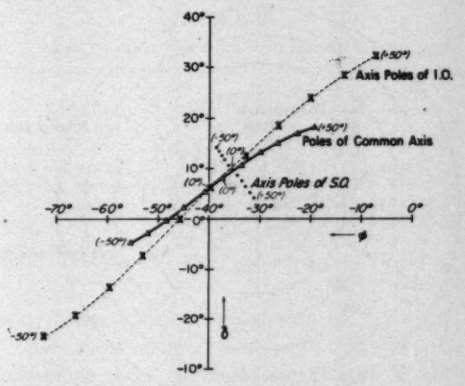

Fig. 4 (Boeder). Locations of axis poles of superior and inferior obliques and the curve along which the pole of the common axis travels when the eye assumes different positions of adduction and abduction.

change as indicated in Figure 4. Consequently the common axis of the pair is not invariant in adduction and abduction but has a pole that moves along the curve from $\varphi = -19°, \vartheta = +18°$ to $\varphi = -55.5°, \vartheta = -4.5°$ when the eye abducts from $\varphi = +50°$ to $\varphi = -50°$. This arrangement has its advantage, for if the axis were fixed, say at $\varphi = -37°$, there would be an automatic reversal of function of the muscle pair whenever the eye abducted beyond it. The variable axis avoids this: as the line of fixation turns out, the axis stays ahead of it, never allowing it to pass.

Figure 4 shows that the locus of the axis poles of the superior oblique crosses the locus of the axis poles of the inferior oblique. The consequence of this is that the co-contracting oblique muscle pair could act as an adductor when the eye is in positions of adduction and as an abductor when the eye is in positions of abduction.

The angle ω, that is, half the angle between corresponding axis poles, increases nearly linearly from less than 3° when the eye is in the primary position (the minimum of ω occurs at about $\varphi = +5°$) to about 18° when the eye is adducted to $\varphi = +50°$, and to 25° when the eye is abducted to $\varphi = -50°$. The corresponding torques of the co-

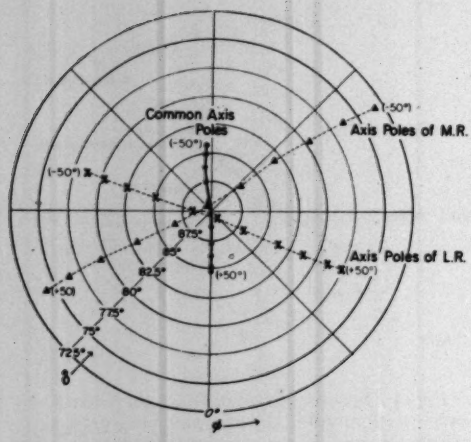

Fig. 5 (Boeder). Locations of axis poles of medial and lateral recti, and the curve along which the pole of the common axis travels when the eye assumes different positions of elevation and depression.

contracting muscle pair increase from a negligible value in the primary position to about 30 percent of that of the medial rectus pair in extreme adduction and to about 42 percent in extreme abduction. However, the axis of the co-contracting muscle pair is never vertical. In extreme adduction its axis pole is located at $\varphi = +90°$, $\delta = +50°$, and in extreme abduction at $\varphi = +28°$, $\delta = +50°$. It follows that only about 75 percent of the action of the co-contracting muscle pair would go into adduction or abduction, the rest would go toward depression and excycloduction in adduction and toward elevation and incycloduction in abduction.

Horizontal muscle pair

In the primary position, the axis of the horizontal rectus pair is almost precisely vertical and it remains so when the eye turns out. In extreme adduction, however, the axis inclines about eight degrees (at $\varphi = +40°$) with the result that there are small components of depression and excycloduction.

For initial positions of elevation and depression along the vertical meridian through the primary position, the axis poles of the medial and lateral recti change as shown in Figure 5, and the pole of the common axis of the pair moves along the curve. It follows that for initial positions of elevation, there is a component of excycloduction in adduction and of incycloduction in abduction. For initial positions of depression, there is a component of incycloduction in adduction and of excycloduction in abduction.

Since ω, half the angle between the axes of the individual muscles, increases from practically 0° in the primary position to about 13° for $\delta = +50°$ and $\delta = -50°$, the co-contracting horizontal muscle pair could act as an elevator in positions of elevation and as a depressor in positions of depression with a torque that increases from zero to about 45 percent of that which this muscle pair has in its primary function.

Figure 6 shows the traces which the line of fixation would make on the concentric sphere if the three contracting-extending muscle pairs acted individually from initial positions corresponding to those of Figure 1. The important difference between the action of pairs and that of single muscles as shown in Figure 1 is the loss of independence of antagonists which manifests itself best in the

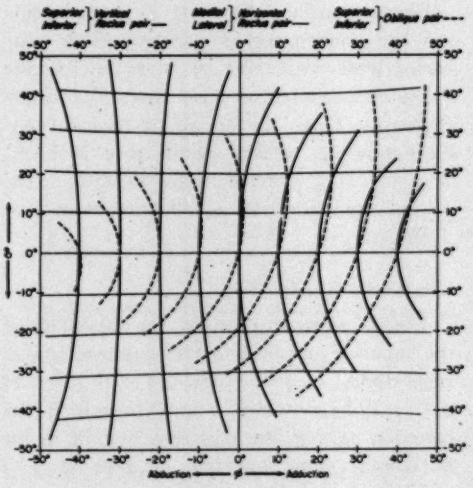

Fig. 6 (Boeder). Traces of the line of fixation when the three muscle pairs act individually from positions corresponding to Figure 1.

smooth transition from one action to the opposite action, for example, from elevation to depression.

Co-operation of all extraocular muscles

The co-operation of two muscles in a pair reduces the number of individual units from six to three. The action analysis of these muscle pairs, though yielding significant information, is still hypothetical because in any actual rotation of the eye, the pairs in turn have to surrender their theoretical independence and merge into a single muscle unit with a single axis of rotation at any given moment.

In studying the action of this complex muscle unit, it is no longer purposeful to ask what kind of rotation would result if the unit were allowed to act from a given initial position of the eye because the answer is well known: The complete muscle unit of the eye can produce an infinite variety of rotations consistent with Listing's law.

Therefore, in order to analyze the action of the muscle unit, the question must be turned about: For a given rotation of the eye, what changes take place in the contractive state of the individual muscles; and what are the individual muscles' contributions toward a given excursion of the eye?

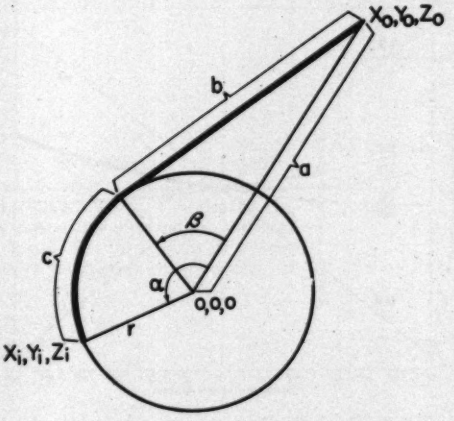

Fig. 7 (Boeder). Diagram used in determining the length of an ocular muscle.

TABLE 2

Length of muscles of Volkmann's eye

Muscle	Length in Mm.	Arc of Contact	
		Degrees	Mm.
Superior rectus	41.96	39° 12′	8.38
Inferior rectus	42.49	42° 9′	9.01
Lateral rectus	49.11	69° 21′	14.83
Medial rectus	38.51	29° 22′	6.27
Superior oblique	22.28	23° 4′	4.93
Inferior oblique	35.35	79°	16.89

The most direct analytical method of answering these questions consists of determining the change in length of the individual muscles during a given excursion of the eye under the assumption that there is no muscle slack in any equilibrium position of the eye.

In applying this method we must calculate the lengths of the individual muscles in the primary position. For the present purpose we shall modify Volkmann's data by moving the center of the globe of radius 12.25 mm. 1.29 mm. back into coincidence with the center of rotation, a change which does not significantly affect the results. By "length of muscle" is meant here the total length of muscle plus tendon from the muscle's origin to the midpoint of its insertion, except that the length of the superior oblique is counted from the trochlea instead of its origin.

With the aid of Figure 7, where x_o, y_o, z_o are the co-ordinates of the muscle's origin; x_i, y_i, z_i, the coordinates of its insertion; r, the radius of the globe; c, the arc of contact; $b + c = 1$, the length of the muscle, we have

$$a^2 = x_o^2 + y_o^2 + z_o^2,$$

$$\cos\alpha = \frac{x_o x_i + y_o y_i + z_o z_i}{a \times r},$$

$$\cos\beta = \frac{r}{a},$$

$$c = \frac{(\alpha - \beta) r\pi}{180},$$

$$b = a \sin\beta,$$

$$1 = b + c.$$

Table 2 gives the length of the muscles of Volkmann's eye in the primary position, and

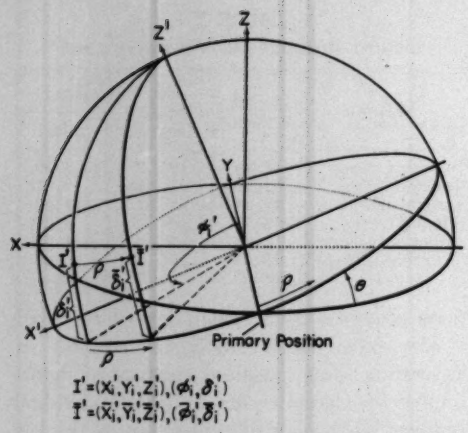

Fig. 8 (Boeder). Diagram used in determining the displacement of the insertion of a muscle in an ocular rotation from the primary to any other position.

the arcs of contact in degrees as well as in mm.: 1.0 mm. of arc of contact is equivalent to 4° 40′.

If the eye rotates from the primary position to any other position in accordance with Listing's law, the insertions of all muscles will be displaced; in particular, the coordinates of a certain muscle's insertion, x_i, y_i, z_i, will change to $\bar{x}_i$, $\bar{y}_i$, $\bar{z}_i$.

Let the meridian along which the line of fixation travels be designated by θ and the extent of the rotation by ρ. Then $\bar{x}_i$, $\bar{y}_i$, $\bar{z}_i$ can be found with the aid of Figure 8 as follows:

Determine the auxiliary coordinates, x_i', y_i', z_i', from

$$\begin{aligned} x' &= x\cos\theta - z\sin\theta \\ y' &= y \\ z' &= x\sin\theta + z\cos\theta \end{aligned} \qquad (1)$$

and ϕ_i', δ_i' from

$$\begin{aligned} x' &= r\sin\phi'\cos\delta' \\ y' &= r\cos\phi'\cos\delta' \\ z' &= r\sin\delta'. \end{aligned} \qquad (2)$$

Then, introducing the rotation, put $\bar{\phi}'_i = \phi_i' + \rho$, and $\bar{\delta}'_i = \delta_i'$. Find $\bar{x}_i'$, $\bar{y}_i'$, $\bar{z}_i'$ corresponding to $\bar{\phi}_i'$, $\bar{\delta}_i'$ by means of (2), and, finally, $\bar{x}_i$, $\bar{y}_i$, $\bar{z}_i$ by means of (1). The displaced insertion, $\bar{x}_i$, $\bar{y}_i$, $\bar{z}_i$, determines a new muscle length which is compared with that in the primary position.

Figure 9 shows the changes in muscle length of all muscles for the case of the eye executing a horizontal rotation ($\vartheta = 0$) between $\varphi = -30°$ and $\varphi = +30°$. The striking fact is that, even in this seemingly uncomplicated ocular rotation, not only the horizontal recti but all other muscles are active, if only to take up the slack and stabilize the eye. The horizontal recti give a perfect example of antagonistic action; when the medial rectus contracts, the lateral rectus extends and vice versa. The superior and the inferior rectus behave almost like a single muscle; they co-extend in positions of abduction and co-contract in positions of adduction. The oblique muscles show a combination of antagonistic action and co-contraction, if the latter is regarded as the average between the two actions.

Figure 10 shows the changes that occur in the contractive state of all muscles when the eye executes a radial rotation of 30 degrees from the primary position along any meridian θ. For instance, if we want to know the change for $\theta = 45°$, which corresponds to a 30-degree rotation from the primary position to a position "in and up," we find from Fig-

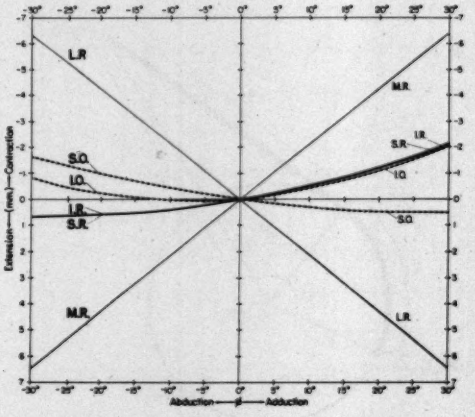

Fig. 9 (Boeder). Changes in muscle length of all extraocular muscles occurring in a horizontal rotation.

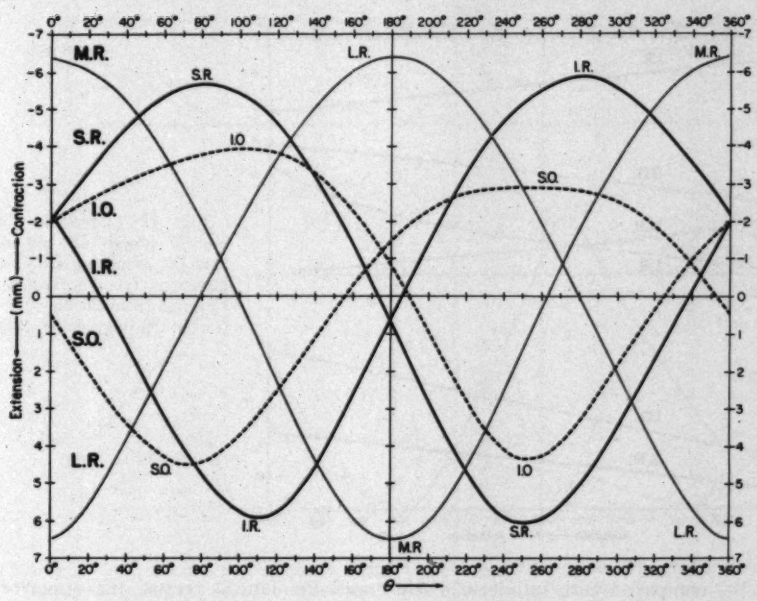

Fig. 10 (Boeder). Changes in muscle length of all extraocular muscles occurring in radial rotations of 30 degrees from the primary position.

ure 10 that the medial rectus, the superior rectus and the inferior oblique contract 4.9, 4.8, 3.2 mm. respectively and the superior oblique, the lateral rectus and the inferior rectus extend 3.7, 3.4, 1.8 mm. respectively.

If we now assume that for any position φ, ϑ of the eye, there exists one and only one set of contractive states of the six muscles, no matter how the position is reached, we can find the minimal total change in contrac-

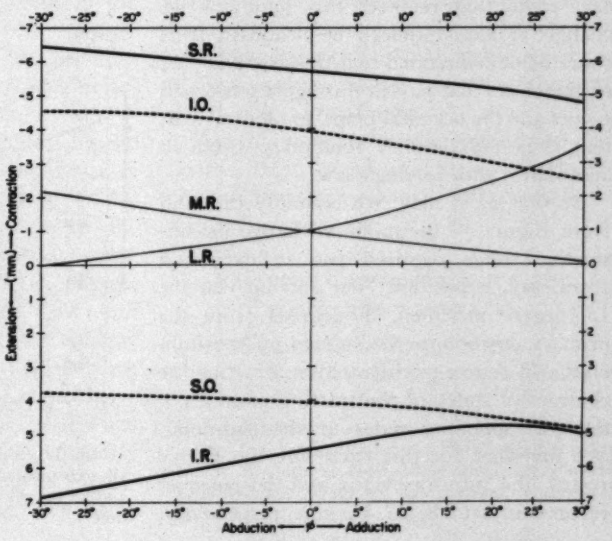

Fig. 11 (Boeder). Changes in muscle length of all extraocular muscles occurring in 30-degree elevations from horizontal positions ranging from 30 degrees of abduction to 30 degrees of adduction.

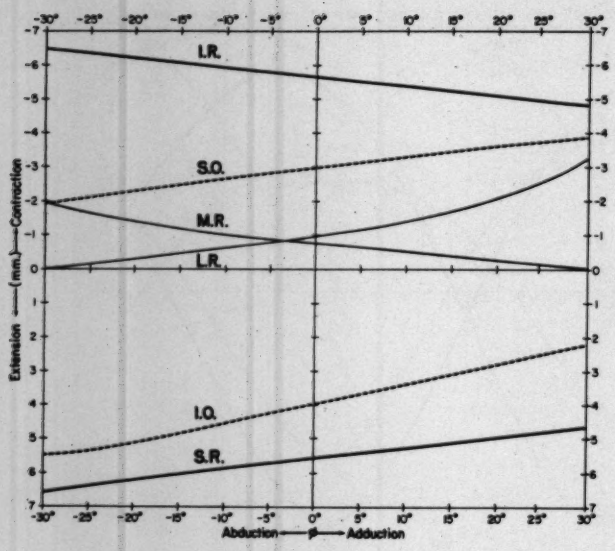

Fig. 12 (Boeder). Changes in muscle length of all extraocular muscles occurring in 30-degree depressions from horizontal positions ranging from 30 degrees of abduction to 30 degrees of adduction.

tive state (as compared with infinitely many others that, because of more devious routes, include additional changes and their cancellations before the arrival at the excursion's end-point) required for an excursion from one position to any other by simply taking the difference of the contractive states corresponding to the two positions. If it turned out that there exists only one "most economical" route that requires this minimum of change, it would indeed be beautiful if it could be demonstrated that this route is part of the circle that passes through its two end points and the occipital point, in other words, that it is the simplest rotation possible in accordance with Listing's law.

Be that as it may, we certainly can find from Figure 10 the minimal change in contractive states required for an excursion from, say, a position "out and up" on the 135-degree meridian, 30-degrees from the primary position, to the "in and up" position on the 45-degree meridian, by subtracting the contractive states of the starting point from the corresponding states of the end-point. We find that for this excursion the medial rectus, the inferior rectus and the superior rectus contract 8.8, 3.2, 1.2 mm., respectively, and the lateral rectus, the superior oblique and the inferior oblique extend 8.2, 2.2, 0.3 mm., respectively.

When such differences are taken, it must be remembered that the resulting contractions and extensions are no longer counted from the primary position and that, consequently,

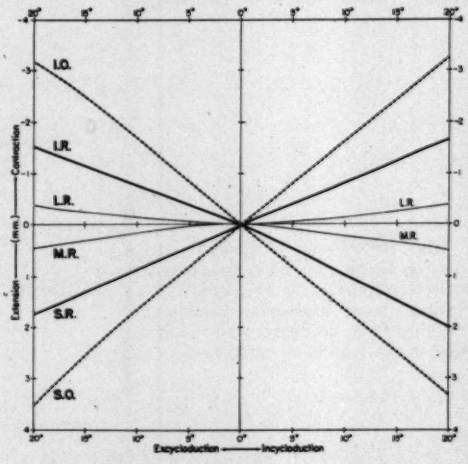

Fig. 13 (Boeder). Changes in muscle length of all extraocular muscles occuring in excycloduction and incycloduction with the eye in the primary position.

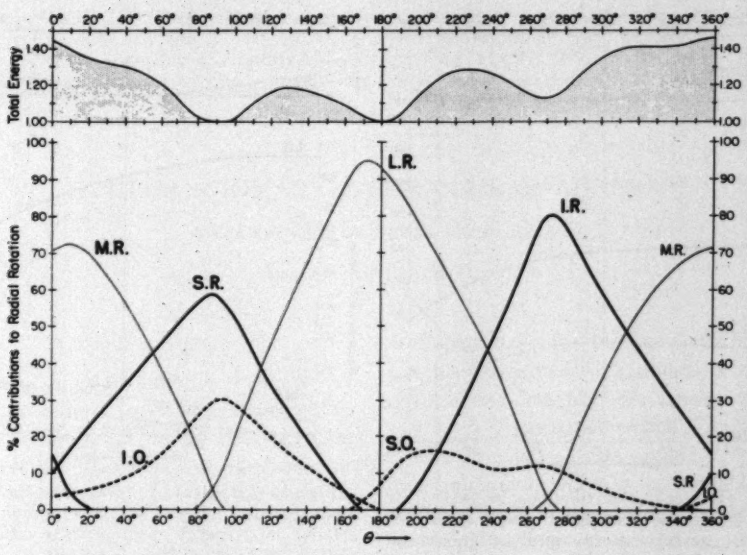

Fig. 14 (Boeder). Contributions in percent to radial rotations of 30 degrees from the primary position. The upper graph shows the relative total muscular energy spent in these rotations.

contraction may mean additional contraction, or cancellation of extension plus contraction, or merely total or partial cancellation of extension, as the case may be. A similar observation must be made in regard to extension.

Figure 11 shows the minimal changes in contractive state that occur when the eye elevates from any horizontal position in the interval $\varphi = -30°$ to $\varphi = +30°$ to the position directly above it on $\vartheta = +30°$, and Figure 12 shows these changes for 30-degree depressions.

The most striking fact revealed in Figure 11 is that in the entire interval the elevators contract in a ratio that does not stray far from 3:2, the superior rectus always providing the larger part. If we again put the muscular forces proportional to their average cross sections, namely 11.34 and 7.89 mm.^{2} respectively, we find that the inferior oblique, on the average, does only about half as much work in elevation as the superior rectus.

This result clashes with the traditional view that in adduction it is predominantly the inferior oblique that is doing the elevating. This idea is derived from the oversimplified picture of the eye having one vertical and two horizontal axes of rotation, tacitly assumed to remain fixed in elevations and depressions. The truth is, however, that the axes of all three muscle pairs undergo enormous variations when the line of fixation leaves the horizontal plane. It is impossible, therefore, to synthesize, from hypothetical, fixed-axis-rotations caused by the action of individual muscles as shown in Figures 1 and 6, the cooperative action of extraocular muscles in normal rotations.

Figure 13 shows the changes in the contractive states of all muscles in excycloduction and incycloduction when the eye is in the primary position.

Relative contributions of the contracting muscles*

A measure of the energy spent, or work done, by a muscle in a given excursion is

* All contracting muscles are regarded here as causing the rotation under consideration; that is, no attempt is made at speculating which contractions "actually" contribute to the rotation, and which might not.

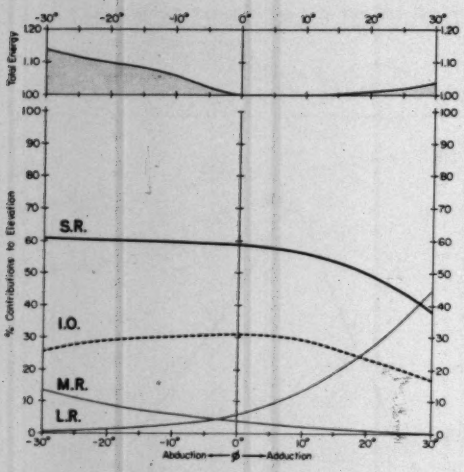

Fig. 15 (Boeder). Contributions in percent to 30-degree elevations. The upper graph shows the relative total muscular energy spent in these elevations.

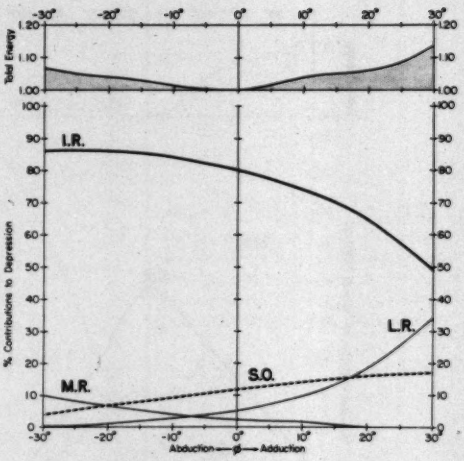

Fig. 16 (Boeder). Contributions in percent to 30-degree depressions. The upper graph shows the relative total energy spent in these depressions.

obtained by multiplying the calculated contraction by the muscle's force, which is proportional to its average cross section. Now, if the work is done in the direction of the rotation, it is more effective than if done at an angle with this direction. We define, therefore, the "average effectiveness" of a muscle in a given excursion as the ratio of the contraction to the total displacement of the muscle's insertion. The muscle's relative contribution to the given excursion is then the product of work times effectiveness.

Figures 14 through 16 present these relative contributions in percent for radial rotations, elevations, and depressions in correspondence with Figures 10 through 12.

The curves at the top of these figures give the relative total muscular energy spent in the respective excursions. For instance, the energy curve of Figure 14 shows that the total work is minimal in the neighborhood of $\theta = 90°$; that is, the radial rotation straight up is the "most economical"; the corresponding total work has been set equal to one. There are two further minima, namely at $\theta = 180°$ and $\theta = 270°$; whereas the absolute maximum occurs at $\theta = 0$. Adduction, therefore, is the "least economical" radial rotation; it requires about 46 percent more work than the minimum.

A graph showing the contributions toward excycloduction and incycloduction has been omitted because the contributions are nearly constant over the whole range shown in Figure 13. Neglecting insignificant contributions by the lateral rectus, we find that, with the eye in the primary position, the inferior oblique contributes to excycloduction about 70 percent and the inferior rectus about 30 percent; whereas the superior oblique contributes to incycloduction about 70 percent and the superior rectus about 30 percent.

University Hospitals.

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LYMPHANGIOMAS OF THE OCULAR ADNEXA*

An analysis of sixty-two cases

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Introduction

Lymphangiomas around the eye are uncommon. Although they have been recognized and reported for nearly 100 years, the reports have been for the most part based on a small number of cases or a limited observation. It seems worthwhile, therefore, to place on record an analysis of a substantial group of cases from two institutions based upon clinical and pathologic examination in order to delineate the features of lymphangiomas in this region.

Definition

Lymphangiomas are congenital, benign, slowly progressive tumors of the lymph-vascular system. The single exception to the benign nature of these tumors is lymphangiosarcoma which has been reported in association with severe lymph stasis following radical mastectomy. The current naming of lymphangiomas is descriptive and includes capillary lymphangiomas, cavernous lymphangiomas, and cystic lymphangiomas. Some texts state that lymphangiomas are comparable to hemangiomas and that comparable types of lymphangiomas exist for every hemangioma.

Elephantiasis is a clinical descriptive name which undoubtedly includes many lymphangiomas but likewise covers conditions without a disturbance of the lymph-vascular system. Some authors divide elephantiasis into congenital, which is presumably lymph-vascular in nature, and acquired, which may be lymph-vascular on the basis of stasis of lymph vessels, or tissue edema related to inflammation and hyaluronic acid disturbance. Hemorrhagic lymphangiomas are those with a prominent element of hemorrhage into the lymph-vascular spaces. Hemangiolymphangiomas are those associated with hemangiomas.

Incidence

It has not been possible to determine the incidence of lymphangiomas from the literature. The present study is based upon 62 cases of which 34 were obtained from among 9,000 successive ophthalmic specimens. This represents an incidence of 0.40 percent with respect to the accession list in this particular pathology laboratory. The number of lymphangiomas in general among all admissions to the medical center of which this ophthalmic institution is part is approximately 140. If the population base for this institution is about one million people, and the length of time during which the cases have been collected is one generation, then the incidence of lymphangiomas is 14 per 100,000 population. Since the 34 lymphangiomas involving the ocular adnexa which are reported from this institution are a portion of the 140 total lymphangiomas, the incidence of lymphan-

* From the Department of Ophthalmology, College of Physicians and Surgeons, Columbia University, and the Institute of Ophthalmology, Presbyterian Hospital. This paper is an abridgement of a candidate's thesis for membership in the American Ophthalmological Society. The cases were collected from the Presbyterian Hospital, New York, and the Armed Forces Institute of Pathology, Washington, D.C.

giomas involving the ocular adnexae works out to 3.4 per 100,000 population. The regional distribution of lymphangiomas in this institution is as follows:

REGIONAL DISTRIBUTION OF LYMPHANGIOMAS

	PERCENT
Scalp and face	20
Lids, conjunctiva, and orbit	19
Neck	15
Chest and back	13
Leg, thigh, and foot	10
Tongue and palate	8
Arm and hand	6
Abdomen	2
Anus and rectum	2
Other sites	3

The distribution of lymphangiomas involving the ocular adnexae is as follows:

STRUCTURES INVOLVED BY LYMPHANGIOMAS ABOUT THE EYE

STRUCTURES	APPROXIMATE PERCENTAGES
Conjunctiva	33
Orbit	25
Lids	8
Lids and conjunctiva	6
Lids, conjunctiva, and orbit	5
Conjunctiva and orbit	4
Face and lids	2
Face, lids and conjunctiva	2
Face, lids, conjunctiva, and orbit	6
Face and orbit	2
Face, lids and orbit	4

PRESENTATION OF CASES

a. LYMPHANGIOMAS OF THE CONJUNCTIVA

Case 1. (Aged 22 years, fig. 1). For four months there had been dilated vessels in the conjunctiva of the right eye temporally. The patient had a blood vessel cut to limit the blood supply of this area without effect. Examination showed a pale watery mass on the bulbar conjunctiva of the right eye extending from the temporal fornix at the canthus to the insertion of the external rectus muscle. A rich blood supply was apparent. With the slitlamp, dilated tortuous capillary channels filled with a clear fluid could be seen. Pigment granules could also be seen with the slitlamp. The diagnosis was lymphangioma of the conjunctiva. An excision and plastic repair were carried out in the operating room. The microscopic description of the specimen was:

"The conjunctiva shows thickened irregular epithelium and in one intra- and subepithelial nest of cells of a nevoid character. In the subepithelial area are collections of lymphocytes and many small endothelial-lined vessels. In one area there is a cyst lined with flat endothelial cells and containing cellular debris."

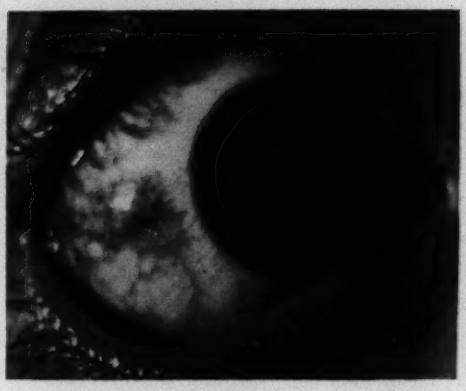

Fig. 1 (Jones). *Case 1.* Lymphangioma of bulbar conjunctiva associated with a pigmented nevus.

This was a lymphangioma associated with a nevus.

Case 2 (Aged 57 years, fig. 2). The patient gave a history of a bloodshot area on the right eye for eight years which cleared from time to time. Examination showed a localized swelling of the bulbar conjunctiva between the 6 and 9-o'clock positions. This was elevated and watery to flesh-colored in nature. A provisional diagnosis of lymphoma of the conjunctiva was made. A local excision of the suspicious lesion was carried out. Microscopic examination of the tissue which was removed revealed numerous small blood vessels and edematous tissue containing many endothelial-lined convoluted spaces. The diagnosis was lymphangioma of conjunctiva.

Case 3 (Aged 29 years). At the time of admission the patient gave a history of a tender red left eye for 12 years. This eye had had previous surgery three times for a cyst of the conjunctiva about 10 years previously. The redness and tenderness would clear for a while and then return. The inflammation present at the time of admission had lasted for about two and one-half weeks. This was a blemish in his career as an actor. The earliest symptom which the patient had noted, 12 years previously, was

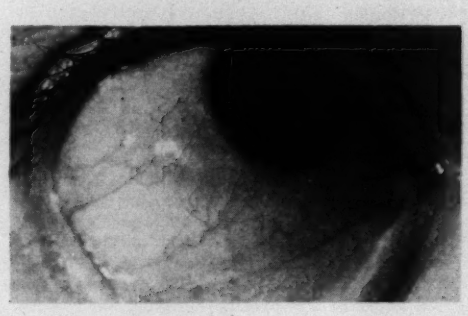

Fig. 2 (Jones). *Case 2.* Lymphangioma of bulbar conjunctiva present eight years.

a protrusion of the inner aspect of the left eye. When it became painful, a cyst was diagnosed and this was treated first with an electric needle and then by attempted excision. However, within two years the condition had returned. Prior to the present inflammatory episode the eye had been clear for six to eight months.

The examination showed an elevated lesion occupying the region of the caruncle and the semilunar fold in the left eye. This was highly vascular and angiomatous in appearance. It extended to the culde-sac above and below and showed adhesions to the lids both above and below. Some scar tissue was present. There was no exophthalmos. The clinical diagnosis was lymphangioma of the conjunctiva. An excision of the mass together with affected conjunctiva was carried out. A plastic repair was instituted. Microscopic examination of the tissue which had been removed showed a gross specimen 7.0 by 4.0 by 3.0 mm. It consisted of epithelium and subcutaneous tissue in the deeper layers of which were numerous endothelial-lined spaces varying markedly in size. Many of the spaces were empty but some contained blood. This was a cavernous lymphangioma with a small but definite lymphocytic element.

Case 4 (Aged 54 years). This patient was seen with a history of several days of irritation of the left eye. A lymphangiectatic-appearing growth was present on the bulbar conjunctiva temporally. Excision under local anesthesia was carried out. Microscopic examination of the specimen showed many large cavernous spaces lined with endothelial cells and containing an eosinophilic homogenous substance. The diagnosis was cavernous lymphangioma.

Case 5 (Age adult). This patient had a cavernous lymphangioma of the semilunar fold. A cystic growth was noted on the semilunar fold 18 months before. This was partially excised two times but refilled and reconstituted itself almost immediately. The third and complete excision was carried out and microscopic examination of the tissue revealed a cavernous lymphangioma with some small cells in the stroma. There was also an epithelial inclusion cyst in the specimen. The present status of the patient is unknown.

Case 6 (Aged 15 years). This patient had a cavernous lymphangioma of the conjunctiva. A hemorrhagic edematous swelling of the semilunar fold of the left eye first became apparent at about the age of three years and slowly became more prominent until the age of 15 years at which time an excision was undertaken. The prominent clinical feature was the presence of recurrent hemorrhages in the edematous swelling. Microscopic examination of the excised tissue showed a cavernous lymphangioma of the conjunctiva with lymphocyctic infiltration aggregated into follicles.

Case 7 (Age adult). This patient noted a lesion of the bulbar conjunctiva temporally in the left eye. A similar lesion had been present on the right eye nine years before. The fate of the lesion on the right eye was not known. The excision of the lesion of the left bulbar conjunctiva revealed a cavernous lymphangioma together with lymphangiectasis.

Fig. 3 (Jones). *Case 9.* Lymphangioma of bulbar conjunctiva present 10 years.

Case 8 (Aged seven months). The patient exhibited since shortly after birth a lesion of the conjunctiva and cornea of the left eye which was thought clinically to be a dermolipoma. Microscopic examination of the excised tissue revealed a limbal epidermoid together with a cavernous lymphangioma.

Case 9 (Aged 23 years, fig. 3). This patient had a cavernous lymphangioma of the bulbar conjunctiva. The history was of having noticed a cyst of the bulbar conjunctiva of the right eye 10 years previously. On several occasions an attempt was made to aspirate the cyst with a needle but each time it filled with blood and the attempt was unsuccessful. Accordingly about 10 years after onset the lesion was excised in toto. Microscopic examination of the removed tissue showed a typical cavernous lymphangioma. Present status of the patient is unknown.

Case 10 (Aged 24 years). This patient had a cavernous lymphangioma of the inner canthus. The history was incomplete but the patient at about the age of 21 years was noted to have a mass involving the inner canthus. This was partially excised. Microscopic examination showed a cavernous lymphangioma with prominent stroma and with very few cells. Within three years the lesion recurred and again was excised. The examination of the specimen was similar to that of the first specimen except that the cavernous spaces were less evident and the stroma was more prominent. Scarring was apparent in the second specimen. The subsequent history is not known.

Case 11 (Aged 65 years). This patient had an irritated eye for two weeks prior to surgery. A cyst was noted on the bulbar conjunctiva temporally and this was excised. Microscopic examination revealed a small cavernous lymphangioma. Present status of the patient is unknown.

Case 12 (Aged 21 years). This patient had a cavernous lymphangioma of the conjunctiva. A mass was present in the conjunctiva for an indefinite period of time and had been diagnosed as a heman-

gioma and removed three years before the present surgery. The tumor recurred in the bulbar conjunctiva. Excision of the specimen and examination revealed a cavernous lymphangioma without other notable features. The present status of the patient is unknown.

Case 13 (Aged 44 years). This patient had a cavernous lymphangioma of the bulbar conjunctiva. A cyst of the conjunctiva had been noted for two or three days. Excision and examination of this specimen revealed a cavernous lymphangioma with very few cells in the stroma. Present status of the patient is unknown.

Case 14 (Aged 13 years). Beginning at the age of five years it was noted that the inner quadrant of the conjunctiva of the left eye became red whenever the patient had a cold. A clinical diagnosis of hemangioma was made and a partial excision was performed. The condition recurred and two years later a partial excision again was performed. The condition recurred and one year later the third and final excision was performed. No recurrence in the five years since the third excision was noted. Ten years after surgery the patient remains well and without recurrence. The pathologic examination of the tissue removed showed conjunctival epithelium with goblet cells and endothelial-lined cystic spaces. A light connective tissue stroma was present with a small lymphocytic element. The diagnosis from the microscopic examination was cavernous lymphangioma of the conjunctiva.

Case 15 (Aged 25 years). The early history was not obtained. At about the age of 21 years a mass was noted nasally in the bulbar conjunctiva of the left eye and a partial excision was carried out. Two years later this recurred and increased slowly and four years after the original excision a new excision was carried out. The microscopic examination of the tissue removed showed a cavernous lymphangioma of the bulbar conjunctiva with a moderate lymphocytic infiltration.

Case 16 (Age unknown). Since childhood a mass had been present in the left upper fornix and this had slowly increased in size. The clinical examination showed a soft cystic avascular mass in the fornix when the upper lid was everted. This mass was excised at surgery and the microscopic examination of the specimen showed a cavernous lymphangioma tending to the cystic type. The connective tissue stroma was sparse and there was very little lymphocytic element.

Case 17 (Aged 18 years). This patient had a cavernous lymphangioma of the bulbar conjunctiva. A mass was noted in the bulbar conjunctiva for an indefinite period exceeding one year. The clinical examination showed an avascular mass approximately 6.0 by 5.0 by 3.0 mm. in size. Microscopic examination of the excised mass showed a cavernous lymphangioma with a slight infiltration of small lymphocytes.

Case 18 (Aged 20 years). This patient had a lump present on the bulbar conjunctiva of the right eye noted for the previous five months. A complete excision was carried out and microscopic examination of the tissue which was removed revealed a cavernous lymphangioma with small spaces and a delicate connective tissue stroma. There was a small cellular element.

Case 19 (Aged 28 years). This patient had a lymphangioma of the bulbar conjunctiva. For an indefinite period previously but especially in the last three months a cyst had been present on the bulbar conjunctiva. This was excised completely and microscopic examination of the specimen revealed a cavernous lymphangioma with a small cellular element.

Case 20 (Aged 33 years). This patient had a cavernous lymphangioma with some features of ectasia. A lump had been noted on the bulbar conjunctiva for one month prior to surgery. The lump had been cauterized leading to disappearance but reformed shortly thereafter. A complete excision and examination of this specimen revealed clear lymph spaces in a loose stroma. This was either cavernous lymphangioma or lymphangiectasia or both.

Case 21 (Aged 44 years). This patient had a cavernous lymphangioma with some ectatic elements. An elevated lesion began laterally on the conjunctiva about one year prior to surgery. This was thought to be a pterygium and was completely excised. Microscopic examination of the tissue removed showed a cavernous lymphangioma with some lymphangiectatic elements.

Case 22. A cyst was present on the bulbar conjunctiva for eight months. A complete excision was carried out. Examination of the excised specimen revealed a lymphangioma (see fig. 26).

b. Lymphangiomas of the lid

Case 23 (Aged 64 years). This patient was seen with a history of having always had a lump on the outer aspect of the right upper lid. In recent weeks this lump had become larger. A clinical diagnosis of dermoid cyst was made. X-ray films were not taken. In the operating room an incision was made parallel to the brow and extending down to the lateral canthus. Blunt dissection revealed a cystic mass in the tissues and this was excised. During the dissection the cyst was opened and necrotic discharge was expressed. Microscopic examination of the tissues which were removed showed fibrous tissue, muscle and orbital fat. Some areas of the fat showed localized lymphocytic collections. Other areas showed endothelial-lined spaces. The diagnosis was lymphangioma of lid and brow.

Case 24 (Aged six years). This patient was first admitted with a history of tissue twice previously being removed from the right side of his nose and lids since the age of one year. The clinical diagnosis was dermoid cyst. Following the second removal the size increased to maximum again within one year. A firm loosely anchored mass approximately 10 by 8.0 by 5.0 mm. was found on the right side of the nose and lids. The tumor was excised and was found to be a mass of fibrous consistency which was grossly a fibroma. A small fossa was observed in the nasal side of the orbit and nose where the mass had rested. Microscopic examination of the tissue showed it to be a lymphangioma.

Fig. 4 (Jones). *Case 25.* Lymphangionma of left side of nose and medial portion of each lid present since birth and slowly increasing in size.

Case 25 (Aged eight years, fig. 4). This patient had a lymphangioma of the conjunctiva and lids. Beginning at birth the left upper lid was noted to be swollen and there was a slow increase in the size of the lid from birth to the age of eight years at which time a partial excision of the lesion was undertaken. The present status of the patient is unknown. Microscopic examination of the tissue removed showed cavernous endothelial-lined spaces with a moderate connective tissue stroma and with prominent blood vessels in the septae of the connective tissue. A prominent lymphocytic infiltration was present with follicles noted at one place.

Case 26 (Age adult). This patient had a cavernous lymphangioma of the right upper lid. A nodule was first noticed in the right upper lid six months prior to excision. The nodule had slowly grown larger and was excised for this reason. The microscopic examination of the tissue removed showed a cavernous lymphangioma with small fairly uniform spaces and with a sparse cellular element.

Case 27 (Aged eight years). This patient had a lymphangioma of the lid. Tissue was first noticed prolapsed from the upper fornix at about the age of two years. A biopsy of the tissue was removed but the results are not known. At the age of eight years an excision of the prolapsed tissue was undertaken and microscopic examination of the specimen removed showed a cavernous lymphangioma with large spaces and a delicate stroma. The cellular element was prominent.

Case 28 (Aged one year). This patient had a cystic lymphangioma of the conjunctiva and lids. A tumor involving the lids and conjunctiva on the left especially on the nasal side was present shortly after birth. This swelling became greater on straining and the conjunctiva protruded through the palpebral fissure. An incomplete removal of the lesion at surgery and examination of the specimen revealed a cavernous lymphangioma with large cystic spaces and some large blood vessels in the connective tissue septae. The cellular element was very small. The present status of the patient and photographs are not available.

Case 29 (Aged 15 years). This patient had a cavernous lymphangioma of the left upper lid. A painless swelling of the left upper lid had been present since birth. There was a gradual enlargement of the swelling. The enlargement was most prominent in the year before excision. Four hundred roentgens of irradiation were given with about one-third decrease in the size of the lesion and excision was then carried out. The microscopic examination of the removed tissue showed a cavernous lymphangioma with collapsed spaces and a prominent stroma. The cellular element was very sparse. Present status of the patient is not known.

Case 30 (Aged nine months). This patient had a cavernous lymphangioma of the right upper lid. The history was of an enlarged right upper lid present since birth and of a tremendous increase in size following recent injury. The right eye was closed due to swelling. Surgery was undertaken and a tumor was located extending from the skin down to periosteum. Microscopic examination of the tissue removed revealed a cavernous lymphangioma with

Fig. 5 (Jones). *Case 31.* (A) Lymphangioma of right side of face present since birth. Many episodes of cellulitis. (B) Close-up view, showing conjunctival lymphangioma which became apparent only in adolescence following cellulitis of face.

tortuous thickened blood vessels and with a very sparse cellular element. The present status of the patient is unknown.

Case 31 (Aged approximately 12 years, fig. 5). This patient was born with a congenital lymphangioma of the right side of the face and had numerous episodes of cellulitis connected with it. Many of these episodes of cellulitis followed injections of sclerosing solutions. Some of them followed pharyngeal infection. The eye was not noted to exhibit lymphangioma until two months before the present examination when it became red and swollen following a cellulitis of the face. The facial cellulitis cleared but the eye did not. She was seen in the eye clinic with a right exotropia, a full upper lid, a depressed inner canthus, and an angiomatous red bulbar conjunctiva. Tissue was removed for microscopic examination and revealed a cavernous lymphangioma. Present status of the patient is not known.

Case 32 (Aged three years). The right upper lid was swollen from birth. At the ages of one and two and one-half years, operations for removal of a growth of the conjunctiva of the right eye were performed. When seen at the age of three years he showed a pale elevation of the semicircular fold and lower fornix with dots of hemorrhage. Tissue was removed for examination and showed lymphangioma. Follow-up information is not available.

Case 33 (Aged 12 years). A swelling of the right lower lid and cheek had been present since birth. This became ecchymotic from time to time. A firm bluish subcutaneous mass measuring 2.5 by 3.5 cm. could be made out. The mass was excised and on microscopic examination showed lymphangioma.

c. Lymphangiomas of the orbit

Case 34 (Aged 23 years, fig. 6; see also figs. 27 and 28). At the time of her first visit this patient gave a history of having had a mastoidectomy at the age of five years, of having had a swelling in her neck at the age of 10 years, and of having had a growth removed from the roof of her mouth at the age of five years. Also, beginning about the age of 13 years, she became aware of a small red swelling at the inner canthus of the right eye. She received several X-ray treatments and had several operative procedures of the right side of the face and neck but none to the eye. The X-rays were directed to the temple region rather than to the eye directly. The patient's main complaint was bleeding from the ocular portion of her tumor.

Examination showed the right fissure to be smaller than the left and there was a palpable mass in the upper and lower lids with a large, fleshy, reddish-brown mass covering the globe nasally. Communicating above and below with the lid masses, palpable tumor tissue was felt in the temple all the way back to the ear. Diagnosis had been made on previous plastic surgery specimens and was lymphangio-hemangioma. Sclerosing solutions had been advised as the treatment of choice. The vision was 20/50, R.E., 20/30 L.E., at the first admission at which time the right globe was displaced 20 mm. down and 15 mm. lateral compared to the position of the left globe. X-ray films showed the left orbit to be normal and the right to be increased in all dimensions. The bone of the upper nasal quadrant of the right orbit also showed increased bone density and the adjacent frontal sinus was clouded. There were no dehiscences. The opinion of the roentgenologist was long-standing tumor, probably hemangioma.

At the age of 27 years, a partial excision of this tumor mass from the lids, orbit and temple was undertaken. Microscopic examination of the tissue which was removed resulted in a diagnosis of lymphangioma. Another pathologist studied the sections and gave a diagnosis of hemangiopericytoma. A third pathologist examined the specimens and gave the diagnosis of "no pericytoma but hemangioma." A fourth pathologist after review of all previous opinions stated as follows:

"I think this is lymphatic rather than blood vascular. Therefore, this is a cavernous cystic lymphangioma. The presence of follicular lymphoid deposits such as are seen in hygroma cysticum reinforces the impression of the lesion being lymphogeneous. Naturally it is benign."

One year later an additional partial surgical removal was undertaken. On the third admission she showed an exophthalmos of eight mm. on the right with minor improvement from previous surgery. Partial excision of the tumor tissue and plastic repair were again undertaken. The pathologist who examined the specimen microscopically, however, reverted to a diagnosis of hemangioma.

At the age of 31 years, the patient was again admitted with a history that the tumor had increased in size in the last few months. Further excision and plastic repair largely of the subconjunctival tumor masses of the right eye and orbit were carried out.

At the present time the most pressing problem is the rapidly re-establishing pseudopterygium of the conjunctiva of the globe nasally on the right. This threatens to compromise the cornea and also threatens to extend between the lids. More surgery to attempt a removal of this is contemplated.

Case 35 (Aged eight years). The left eye was injured at the age of one year by falling on the sharp end of a pencil which penetrated the upper lid. There was no damage to the globe. At the age of two years a marked proptosis developed and at two and two-thirds years of age it began to recede spontaneously. X-ray films of the skull and orbits were negative. At the age of six years the eye again proptosed but receded spontaneously. At eight years of age, approximately three months before the present admission, the proptosis again developed during the course of a cold. Coincidentally a left convergent squint developed. The ear, nose and throat workup was negative. Vision was: 20/15, R.E., 20/70, L.E. Exophthalmometer showed five mm. of left proptosis. No tumor mass was felt. Visual fields were normal. Further X-ray films showed the left orbit to be larger than the right in all dimensions but there were no dehiscences.

The patient was taken to the operating room and through a Krönlein approach the orbit was opened. A tumor mass was palpated within the muscle cone and was exposed. It turned out to be soft, compressible, purplish-blue in color with a smooth capsule. During blunt dissection, the capsule was ruptured and the mass collapsed. The type of fluid present could not be identified because of profuse bleeding from surrounding tissues. As much of the wall of the cyst as possible was removed.

Microscopic examination of the tissue which was removed showed it to be a portion of the wall of a lymphangiomatous cyst possibly associated with an old hematoma. The wall was fibrous tissue without any recognizable lining cells. It was felt that the endothelial lining had been lost adventitiously.

Case 36 (Aged six months). This patient was first seen at the age of six months with a history of swelling of both of the lids of the left eye noted in the first week of life. This was diagnosed as inflammatory originally but persisted in spite of treatment. In the period from five months to six months

Fig. 6 (Jones). *Case 34.* (A) Lymphangioma of the face, lids and orbit 10 years after onset but before treatment. (B) Appearance after surgery and irradiation. (C) Close-up view of the conjunctiva. (D) X-ray film, showing enlarged orbit.

Fig. 7 (Jones). *Case 36.* X-ray film of a six-month-old patient with lymphangioma of the orbit, showing enlargement on the left.

of life the swelling became considerably greater. There were no birth marks elsewhere on the body. Clinical examination showed no exophthalmos but redness of the left side of the nose, left brow, lids, left cheek and left side of the mouth. No mass was palpable and there was no obvious exophthalmos. Chemosis of the lower bulbar conjunctiva and palpebral conjunctiva with moderate injection were present. The caruncle was enlarged. A diagnosis of possible hemangioma of the left orbit was made. After consultation the diagnosis was amended to lymphangioma of the left orbit and face. X-ray films (fig. 7) of the skull and orbits showed the left to be larger in all dimensions than the right. There were no dehiscences of bone. The impression of the radiologist was congenital deformity involving the left orbit. A biopsy of the conjunctiva was undertaken and microscopic examination revealed a lymphangioma.

Case 37 (Aged eight years, see fig. 29). Five months previously, following measles, the right eye began to protrude. The protrusion increased slowly and two months prior to admission the exophthalmos on the right was found to be six mm. The vision was unaffected. There was no bruit. Examination showed the right eye to protrude forward, down, and slightly to the side. Exophthalmos at the time of the examination was four mm. The impression was retrobulbar tumor of unknown nature. X-ray films of the skull and orbit showed them to be comparable in size and shape. The patient was taken to the operating room and through a Krönlein approach the right orbit was explored. A tumor mass was felt above the optic nerve and a dark-blue cystic tumor was brought into view. During attempted dissection the cyst broke and old blood was evacuated. The entire cyst apparently was removed from the orbit. The bone flap was repositioned and the soft tissues were closed. The specimen which was removed measured 19 by 12 by 11 mm. Microscopic examination showed a multilocular cyst with an indistinct, thin, endothelial-lined surface. The wall of the cyst contained collections of lymphocytes with follicle formation. Some of the cells contained pigment which was thought to be the result of old blood. The diagnosis was lymphangioma of the orbit. The patient has remained free of symptoms since surgery.

Case 38 (Aged 15 months, fig. 8). Nine days prior to admission a rapidly developing proptosis of the right eye occurred together with a temperature of 99.4°F. The temperature subsided in one day. Examination revealed a firm proptosis of the globe, reddish in color, with no fluctuation. The proptosis measured about 10 mm. X-ray films of the orbit showed the right to be a trifle larger in all dimensions than the left. There were no dehiscences of the bone.

The right orbit was explored through conjunctiva and a large multiloculated bluish cyst was encountered which extended over the upper one-half of the globe. The cyst was entered and dark chocolate-colored fluid escaped. The dissection of the cyst was carried posteriorly almost to the apex of the orbit. The entire cyst wall was not removed but several representative specimens were.

Microscopic examination of the tumor which was removed showed numerous large blood vessels in the specimen, some having thick fibrous walls. There were many small capillaries with evidence of old and recent hemorrhage. The diagnosis was angioma of orbit and hematoma of orbit. Re-examination of

Fig. 8 (Jones). *Case 38.* Orbital lymphangioma with hemorrhage and acute inflammation of nine days' duration.

Fig. 9 (Jones). *Case 39.* (A) Orbital lymphangioma with hemorrhage and increased proptosis. (B) Close-up view, showing remains of ecchymosis in the conjunctiva.

the specimen showed endothelial-lined spaces with clear fluid content. This appeared to be an orbital lymphangioma.

Case 39 (Aged 13 years, fig. 9; see also fig. 30). The patient was admitted with a history of having had a skin eruption which was thought to be hives one month previously. Within a few days both eyes puffed up and a blood vessel ruptured on the right eye. The local eye doctor found a fluctuating mass which was aspirated and dark old blood obtained.

The examination showed a divergent right eye with dilatation of the anterior ciliary veins over the lower half of the limbus. Five millimeters of right exophthalmos was present. The vision was 20/15, R.E., and 20/20 L.E. X-ray films showed increased orbital dimensions on the right together with increased soft tissue density. There were no dehiscences of bone.

The provisional diagnosis was hemangioma of the right orbit and the patient was taken to the operating room where the orbit was explored through a Krönlein approach. A tumor mass was identified below the globe in the inferior part of the orbit and an attempt was made to dissect it out. During this attempt the capsule of the mass was broken and a large amount of dark old blood was evacuated. The remainder of the capsule was excised, the bone flap was replaced and the tissues closed.

The specimen consisted of large multilocular cysts without the usual well-formed endothelial lining.

Fig. 10 (Jones). *Case 40.* (A) Orbital lymphangioma, with proptosis present constantly. (B) Same patient during increased proptosis and ecchymosis.

The lining cells were flattened and the walls of the cyst were irregular in thickness. The initial pathologic diagnosis was hematoma of orbit. Further examination indicated this to be a hemorrhage into a cystic lymphangioma of the orbit.

Case 40 (Aged 17 years, fig. 10). The first hospital admission was at the age of 17 years, at which time the patient gave a history of having a bloodshot right eye since age six. Beginning about the age of 10 years, the right eye became prominent and a diagnosis of abscess behind the eye was made. An exploratory operation was carried out through the medial portion of the right upper lid with a partial ethmoidectomy. Several pieces of tissue were removed and showed a chronic inflammatory process. Following surgery the eye turned out. The vision at the time of the surgery was 20/30, R.E., 20/20 L.E. One year later the exophthalmos recurred and again a partial ethmoidectomy was performed, with improvement. One year later the exophthalmos again recurred. This time no inflammatory process could be found. Iodides and mercury were given without results.

The examination at the time of the patient's admission to the hospital in 1935, when she was 17 years of age, revealed six mm. of right exophthalmos with 45 diopters of exotropia. Her vision still corrected to 20/20 in each eye. Ecchymosis was present in the medial portion of the right upper lid. There was a weakness of the internal rectus and of the superior oblique. The examination was otherwise negative and the diagnosis of pseudotumor was made. X-ray films taken at this time showed marked asymmetry of the orbits. The left was normal and the right was strikingly enlarged in all dimensions. The impression of the radiologist was that this was a manifestation of long-standing increased intra-orbital pressure.

An orbital exploration was undertaken through a lateral canthotomy incision. A soft lobular flattened mass was palpated along the lateral wall of the orbit extending into the apex. This was removed.

The microscopic examination revealed lacrimal gland, striated muscle, and orbital fat, none of which was abnormal. Tissue removed at one of the previous operations was obtained and showed chronic inflammation. Accordingly a provisional diagnosis of pseudotumor was entered.

The patient was readmitted two months later and an exploration was carried out through the bulging conjunctiva. A mass of subconjunctival fibrous tissue was removed from the floor of the orbit. Again a soft lobulated mass was felt in the orbit and a portion of it was removed. The specimen under the microscope showed fibrous tissue and fat with a lymphocytic infiltration. There were areas of old hemorrhage. Several irregular cavernous spaces with endothelial lining and clear fluid content were present. This was a lymphangioma of the orbit with hemorrhage into it. Three years after her original admission she was again admitted with proptosis of the right eye. This time the exophthalmos measured five mm. She was treated with prontylin without any change in appearance.

Case 41 (Aged 23 years). The right side of the face had been swollen since the age of four months. At the age of two and one-half years a biopsy specimen was taken and reported as lymphangioma. At

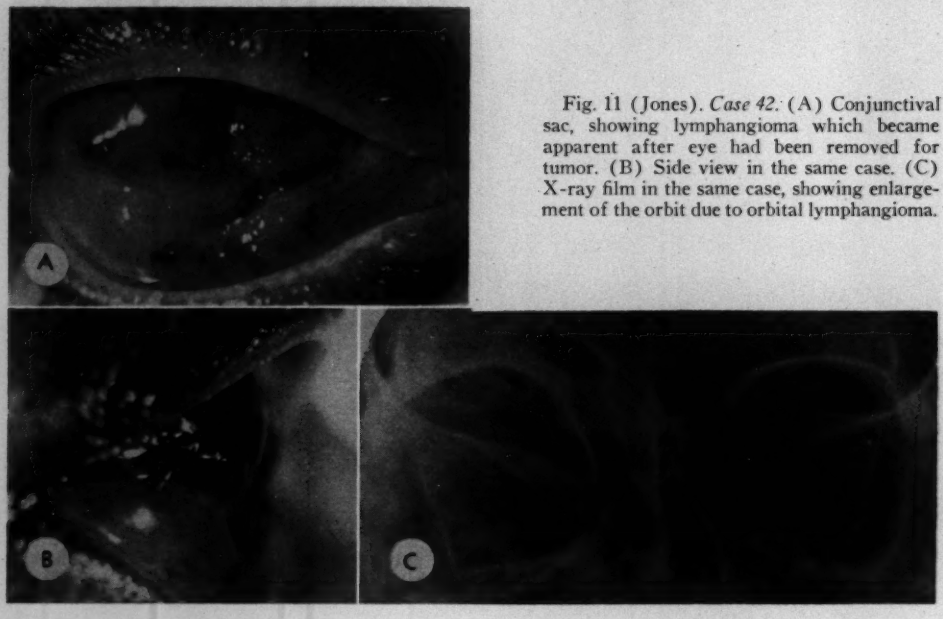

Fig. 11 (Jones). *Case 42.* (A) Conjunctival sac, showing lymphangioma which became apparent after eye had been removed for tumor. (B) Side view in the same case. (C) X-ray film in the same case, showing enlargement of the orbit due to orbital lymphangioma.

three years of age, the lesion was described as follows:

"The upper surface of the right upper lid is the seat of a soft papillarylike lesion about 2.0 by 2.0 mm. The eyelid is swollen. The under surface of the lid shows a soft elevated lesion. The mucosal surface of the upper lid on the right side shows a soft papillary lesion."

The patient experienced recurrent attacks of swelling and redness of the right cheek and eyelid at about monthly intervals. These attacks lasted about two to four days sometimes with injection and discharge of pus from the eyes and the nose. The temperature sometimes went to 104° F. during attacks. At the age of eight years, the lesion was described as a granular, bluish, mottled lesion of the right hard and soft palates typical of lymphangioma.

At the age of 11 years, there was noted an area of ecchymosis at the right inner canthus present for six weeks. Two days before the observation it suddenly became much larger. The mother associated the increase in the swelling with the onset of menstrual periods. At the inner angle of the right upper lid the raised red tissue was apparent with fullness of the orbit opposite this site. For the first time two mm of exophthalmos of the right eye was noted. Verrucalike lesions were present along the lid margin in the area previously diseased. Radiation treatment had been given and the patient showed a radiation cataract.

At the age of 19 years, the patient was seen with a marked subconjunctival hemorrhage and hemorrhage into the caruncle on the right. At 21 years of age, a nodular area in the right cheek was noted and this was treated with radon seeds. At the time of admission at the age of 23 years, a biopsy of the subconjunctival tumor was undertaken in the operating room. Grossly the tumor was reddish and soft but somewhat fibrous in nature. A partial dissection was carried out. During this dissection a blood cyst was encountered and ruptured, allowing the escape of some old dark-brown blood. Microscopic examination of the tissue showed it to be characteristic lymphangioma with marked fibrous thickening of the tissue around the lymphatic vessels. X-rays of the orbit showed no disturbance in size or shape.

The patient was last seen at the age of 28 years at which time there was no change in the appearance of her eye. Correspondence with the patient at the age of 36 years indicates that there still has been no change in the appearance of the eye.

Case 42 (Aged 42 years, fig. 11) At the time when first seen this patient gave a history of having had a "tumor of the right eye" at the age of 11 years, for which the eye was removed. At the age of 35 years, the empty socket began to swell whenever she had a cold. The swelling would come and go and there was some pain and discharge from the socket at the time of swelling. Examination showed the entire region around the eye to be swollen. There was a hard round mass present at the inner upper angle of the orbit and a similar but a smaller firm mass was present in the lower portion of the orbit. The socket was filled with a soft, red bloody tumor

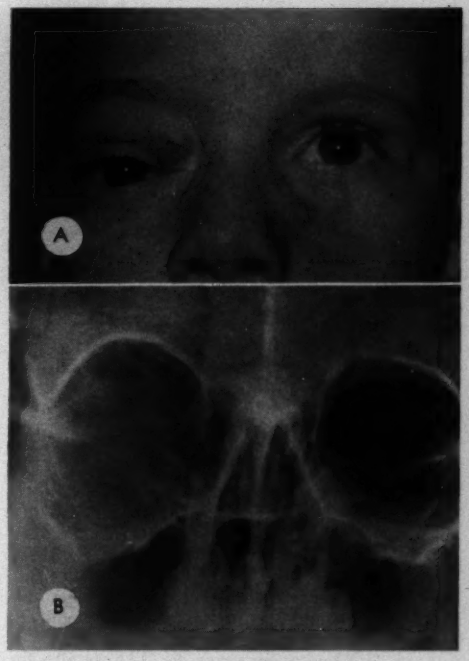

Fig. 12 (Jones). *Case 43.* (A) Exophthalmos and presenting tumor due to blood cyst in an orbital cystic lymphangioma. (B) X-ray film, showing orbital enlargement in same case.

mass irregular in shape. Provisional diagnosis was recurrence of orbital tumor and the patient was admitted for surgery.

X-ray examination of the orbits showed them to be quite asymmetric. The right orbit was much larger in all dimensions than the left. The bone of the lateral wall was thickened but without increased porosity. The spheniod ridge on the right also appeared denser than on the left. A biopsy of the orbital tissue was carried out through conjunctiva and the specimen submitted to microscopic examination. This was reported as normal tissue.

At the age of 41 years the patient again presented herself saying that the right eye was painful and swollen and occasionally subject to bleeding. The examination was similar to that previously noted. X-ray films were again taken and read as showing a congenital deformity of the right orbit, possibly associated with neurofibromatosis. The patient was taken to the operating room for an excision of the orbital tumor. The conjunctiva could not be dissected off the underlying tissue. Accordingly conjunctiva, soft tissues, and the tumor mass in the inferior portion of the orbit were all excised. Microscopic examination of the new tissue was as follows:

"The sections show a complex tumor made up of vessels; some are capillary, some show cavernous

Fig. 13 (Jones). *Case 44.* (A) Presenting tumor and slight proptosis in right eye present since birth. (B) Close-up view, showing swelling of lids, especially the upper lid medially, as well as conjunctival swelling medially. (C) X-ray film of same patient, showing enlargement of the orbit due to cystic lymphangioma.

dilatation, others have smooth muscle in their walls and resemble atypical veins, and some seem to be lymphatics. However, these vessels are diffusely scattered throughout the orbital tissues and some of them are surrounded by fibroblastic proliferation. This is a nevoid type of growth coming from embryonally segregated vascular mesenchyme. Hemangio-lymphangioma of orbit."

The patient was admitted at the age of 42 years to a different service for excision of a tumor of the nasal cavity which was read as cavernous hemangioma. The patient was last seen at the age of 53 years complaining of bloody tears from the right eye. The socket showed some mucopurulent discharge, conjunctival erosions and serosanguinous discharge.

Case 43 (Age seven years, fig. 12; see also fig. 31). A swelling of the right upper lid had been noted for about two years. X-ray films showed the right orbit to be larger in all dimensions than the left. There were no dehiscences of bone. The impression was intraorbital tumor, nature undetermined.

The patient was taken to the operating room where the orbit was approached from the front through a lid incision which was carried down to a dark thin-walled cyst. The cyst was opened and a copious watery brown fluid escaped. The interior of the cyst was explored digitally and found to ramify from the roof to the floor of the orbit on the medial side of the nerve. A considerable portion of the wall which presented was removed for microscopic study. A drain was left in place and the tissues were closed. Microscopic examination of the tumor which was removed led to a provisional diagnosis of hemangioma of the orbit, capillary type, but further study showed it to be typically lymphangiomatous with a large lymph follicle element.

Case 44 (Aged nine years, fig. 13). This patient's parents noticed a small lump at the inner canthus of the right eye shortly after birth. This was thought to be a cyst. At about the age of three years it was concluded that this was growing and should be excised. An intraorbital cyst connecting with this mass was removed at the age of three and one-half years. It was thought to be a clean excision. A definite diagnosis was not made but the tissue was said to be benign. Following the surgery the right upper lid exhibited ptosis.

Several times over the two years prior to the present admission hemorrhages occurred with the lids and globe becoming black and blue. The patient's nose was always stuffy on the affected side. The swelling varied from day to day and the growth recurred in the upper lid. Just prior to admission a diagnosis of angioma was made and surgery was not advised.

Vision was found to be 20/40, R.E., 20/25, L.E. Five millimeters of exophthalmos was present on the right and a smooth rounded mass was palpable in the upper inner aspect of the orbit. The inner canthus and nasal conjunctiva had a reddish discoloration. X-ray films of the orbits showed the right to be a trifle larger in all dimensions than the

Fig. 14 (Jones). *Case 45.* (A) Photograph, showing acute inflammatory episode with proptosis and swelling of the lids due to lymphangioma in the orbit. (B) Side view of the same patient.

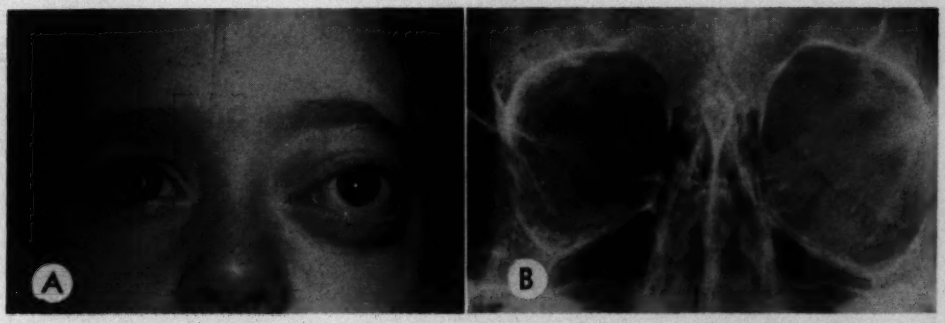

Fig. 15 (Jones). *Case 46.* (A) Exophthalmos following trauma to the left eye. Surgery revealed a blood cyst in a lymphangioma. (B) X-ray film, showing orbital enlargement in this same patient.

left. There were no dehiscences of bone. The impression of the radiologist was that this might be a case of neurofibromatosis. Several consultants saw the case and a provisional diagnosis of lymphangioma was made.

In the operating room the conjunctiva was incised over the right caruncle and the underlying tissue was dissected out. An incision was made through skin over the upper nasal orbital margin, the tumor mass was identified, and an attempt was made to excise it. It collapsed during the dissection but a part of the wall of the tumor was removed for examination. Microscopic study revealed the tissue to consist of large irregular spaces lined with endothelium. Some of these spaces contained blood. Many thin-walled blood vessels were scattered throughout the specimen. In some areas there were concentration of lymphocytes about the smaller vessels. The initial impression of the pathologist was hemangioma, cavernous type, but further study indicated it to be a cavernous lymphangioma.

Case 45 (Aged four years, fig. 14). This patient was admitted to the hospital with a history of episodes of orbital and lid swelling on the right associated with ecchymosis and pain. These had a duration of three to four days. There was a history that a bruit had been heard at various times. Prior to admission a carotid clamp had been put in place but the bruit disappeared and the clamp was not tightened. At the time of admission an acute exacerbation had been in evidence for two days but was spontaneously improving.

A provisional diagnosis of orbital cystic lymphangioma was made. Pediatric consultation revealed no disease in other parts of the body. X-ray films of the skull and orbit showed the right to be slightly larger in all dimensions than the left. Carotid arteriography was performed and showed no abnormality. A radiotherapy consultation was obtained and it was agreed to give the patient some radiotherapy prior to surgery. The situation became entirely quiescent following this and the patient was discharged.

Three days following discharge the patient was readmitted with an acute exacerbation of the orbital swelling with tense skin, heat, pain and a dusky-red appearance. The patient was taken to the operating room and under general anesthesia a Krönlein approach to the orbit was carried out. No discrete orbital mass could be found but rather a diffuse infiltration of the tissues. Several specimens were taken for microscopic examination. The lateral orbital wall was removed for decompression.

Microscopic examination of the tissue which was removed proved it to be not entirely representative. One reading of the tissue resulted in a diagnosis of pseudotumor, lymphangioma, and hemangioma. Another reading led to a diagnosis of orbital granuloma, and a third reading was lymphangioma of the orbit.

Case 46 (Aged six years, fig. 15). This child was first seen at the age of three years with a history of having been hit in the left temple area with an olive bottle two years previously. Following this the patient developed a marked left exophthalmos. X-ray films taken at the age of three years showed increased orbital dimensions on the left side but no dehiscences of the bone. Surgery was recommended but refused at that time.

The present admission at the age of six years was occasioned because of an increase in the exophthalmos of the left eye. The vision was still unaffected. Palpation revealed a soft fluctuant mass in the upper inner angle of the left orbit. A provisional diagnosis of hemangioma of the left orbit was made and X-ray films were taken. These demonstrated that the left orbit was still greater in capacity than previously. There were no dehiscences of bone. The impression of the roentgenologist was hemangioma of the left orbit.

The patient was taken to the operating room and the orbit was explored through a Krönlein approach. A large ramifying purplish tumor, which appeared to be a hemangioma and which contained old blood, was excised in pieces, following which the bone flap was replaced and the soft tissues were closed. The tissues all showed dense scar tissue with heavy infiltration of lymphocytes and plasma cells. There were deposits of pigment which appeared to be old blood pigment. Fresh hemorrhage was present and a concentration of lymphocytes was seen around the large well-formed blood vessels. Several cystic

Fig. 16 (Jones). *Case 47.* (A) Clinical appearance of lymphangioma of the face, lids, and orbit present since birth and subjected to surgery several times. (B) Close-up view, showing the conjunctival portion.

endothelial-lined spaces were present. The pathologic diagnosis was lymphangioma of the orbit.

Case 47 (Aged 19 years, fig. 16). At the time of admission to the hospital this patient gave a history of having had a lymphangioma of the left side of her face since the age of two and one-half years. This had been infected at different times and several operations had been performed elsewhere. There was a severe proptosis of the left eye followed by loss of vision and a cyst formation on the eyeball. Partial removal had been tried but the cystic area grew back. Aspiration was tried with no improvement. The examination showed no vision in the left eye. The inner canthus was displaced four mm. temporally, forward and down. Starting at the limbus and extending to the caruncle there were large translucent cysts of the conjunctiva and smaller cysts of the fornix. X-ray films showed no difference in the orbits. There were several calcium concretions overlying the left antrum. In the operating room an excision of the subconjunctival cystic area was carried out. The microscopic examination of the specimen which was removed showed a dense fibrous tissue stroma with branching clear channels lined with endothelium. Some of these contained blood. The diagnosis was lymphangioma. The present status of the patient is not known.

Case 48 (Aged five years; see fig. 32). Beginning at the age of four years the right eye slowly became more prominent. Six mm. of exophthalmos were measured at the time of admission. X-ray films showed the right orbit to have increased soft tissue density but no difference in orbital dimensions. The patient was taken to the operating room and a Krönlein operation was performed. A multiloculated bluish mass was immediately apparent behind the globe. In the process of dissection this was cut and dark degenerated blood escaped. Several pieces of tissue were taken for biopsy purposes. Microscopic examination of the tissue showed it to consist of many vascular spaces lined with endothelium, some of which contained blood. The diagnosis was lymphangioma of the orbit, cystic type.

Case 49 (Aged 11 years, fig. 17). This patient was first admitted to the hospital at the age of 11 years. He gave a history of having had a tumor of the left eye diagnosed as lymphangioma since the age of two years. He had been admitted to other hospitals where he had repeated treatments with partial excision, sclerosing solutions, and radiotherapy. The history was of a swollen region around the left eye that extended from the bridge of the nose to the middle of the temple and below to the infraorbital ridge. There was moderate proptosis of the eye. Tearing had been present since birth. X-ray examination showed no bony defect in the orbit. The patient was taken to the operating room and an incision was made into the conjunctiva of the upper nasal quadrant. The conjunctival tissue was grasped, dissected and excised. Microscopic examination of

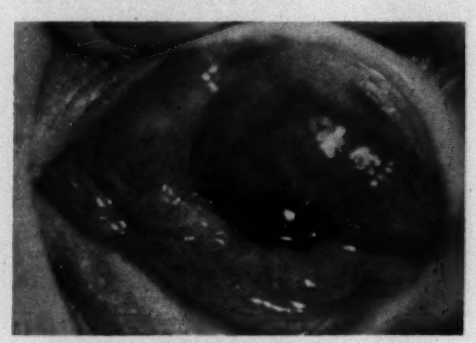

Fig. 17 (Jones). *Case 49.* Conjunctival manifestation of an orbital lymphangioma. This case was shown in Reese's *Tumors of the Eye.*

this specimen showed lymphangiomatous channels lined with endothelium. These were partly obscured by a proliferation of blood capillaries which were thought to be secondary to the radiation treatment and not part of the lymphangiomatous process. The patient was last seen at the age of 13 years when the possibility of exenteration of the orbit was raised. This patient has also been reported in Dr. Reese's book, *Tumors of the Eye.*[1]

Case 50 (Aged 45 years, fig. 18). The history was that one year previously the right eye was noted to bulge. When admitted to the hospital the patient was found to have 20/20 vision in both eyes with no appreciable correction necessary for the left and with one diopter of plus necessary for the right. Exophthalmometer reading showed six mm. of exophthalmos on the right. X-ray films showed the right orbit to be larger than the left and to have a defect in the frontal process of the zygoma. This was felt to represent invasion of the bone by an orbital tumor. Surgery was carried out and a blood cyst of the orbit was found in the floor and lateral portion of the orbit. It extended about half way to the apex. The cyst was ruptured and brownish-red mottled fluid escaped. Pieces of the orbital wall were removed for laboratory study. A defect was found in the bone which corresponded to the blood cyst. Microscopic examination of the specimen showed it to be the wall of a cyst with no epithelial elements noted. All layers showed an infiltration of lymphocytes with a few polymorphonuclear neutrophil leukocytes. A layer of pigment-bearing cells just beneath the inner surface of the cyst wall was noted and this was thought to be hematogeneous pigment. The pathologic diagnosis was blood cyst of orbit. The specimen conforms to a lymphangioma cysticum in which the endothelial lining cells have been lost. This patient has previously been reported by Dr. John Wheeler[2] as an orbital blood cyst.

Case 51 (Age 10 months, fig. 19). The patient was first admitted at the age of 10 months with a history of a soft tumor mass in the upper lid above the caruncle on the left side which appeared soft and compressible but became firm and engorged whenever the child cried. There was a history of injections into this tumor mass elsewhere. A provisional diagnosis of hemangioma was made. X-ray examination revealed no changes from the normal. Aspiration was successful in removing only a few drops of tissue which were examined microscopically and found to be blood. At the age of two years the patient was readmitted with the examination similar to that of the previous admission. An excision of the orbital tumor was carried out. At operation it was found to be tightly connected to conjunctiva and to extend deeply. It was removed in a single piece and was a large, red, fleshy, compressible tumor. Microscopic examination of the specimen showed it to be made up of many vascular channels surrounded by hyperplastic endothelium. Some of the channels were filled with blood. A provisional diagnosis of hemangioma was made. The specimen conforms to the diagnosis of lymphangioma containing adventitious blood. The patient was seen again at the age of 12 years and her vision was found to be 20/15, right, and 20/200, left. She was last seen at the age of 16 years at which time there was no exophthalmos and no remaining sign of the old lymphangioma.

Fig. 18 (Jones). *Case 50.* Right exophthalmos developing in an adult and found to be due to a blood cyst in a lymphangioma.

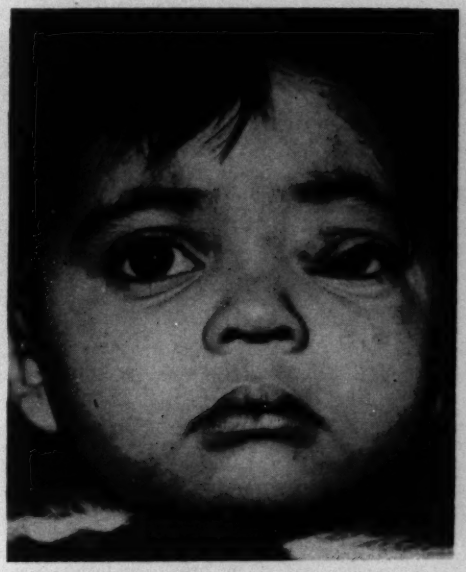

Fig. 19 (Jones). *Case 51.* Lymphangioma of the orbit and left upper lid prior to surgery. The patient obtained a good cosmetic result.

Case 52 (Aged 12 years, fig. 20). This patient had a cystic hygroma or lymphangioma of the orbit. The history was of a proptosis of the right eye with a slow increase which caused the patient to be taken for medical attention first at the age of seven and one-half years. Observation only was carried out. Five years later the proptosis measured five

Fig. 20 (Jones). *Case 52.* Slight exophthalmos on the left in a patient with orbital lymphangioma.

mm. Surgery was undertaken and a specimen was removed. Microscopic examination of the tissue revealed a cystic type of cavernous lymphangioma of the orbit with a prominent lymphocytic element and lymphocytes aggregated into lymph follicles. The present status of the patient is not known.

Case 53 (Aged five years, fig. 21). This patient had a lymphangioma of the orbit. The history was of progressive exophthalmos since birth. A biopsy had been taken at the age of five years. The biopsy diagnosis was lymphangioma. The exophthalmos and disturbance of orbital contents were such that an exenteration was undertaken. The specimen was the globe and orbital contents. Examination showed a lymphangioma of the orbit which apparently arose around the posterior ciliary arteries and which was marked by cavernous spaces with endothelial lining and very prominent round-cell elements. The lesion compressed the optic nerve. The present status of the patient is not known.

Case 54 (Aged two years). This patient had a cavernous lymphangioma of the orbit. The history was that since birth the globe on the affected side had been proptosed and the surrounding tissues had been edematous. A biopsy had been undertaken previously but the results are not known. The patient presented, at the age of two years, a recurrent ecchymosis in the lids with swelling of the lids and proptosis of the globe. An excision of the orbital tissue was undertaken which was probably incomplete. Examination of this specimen showed a cystic variety of cavernous lymphangioma with very large spaces and many collections of lymphocytes. The stromal blood vessels and the connective tissue stroma were rather prominent.

Case 55 (Aged 19 years). This patient had a lymphangioma of the orbit. The history was that the left orbit since birth had contained a slightly proptosed globe with an upper lid which was slightly low. Excision was carried out in infancy but the condition recurred. A partial excision was carried out at the age of 13 years but again there was a gradual recurrence so that, at the age of 19 years, proptosis and ptosis of the upper lid were present. An excision, probably only partial, was carried out and examination of the tissue removed revealed a cavernous lymphangioma with a small cellular element and with prominent blood vessels in the connective tissue stroma.

Case 56 (Aged five years). This patient had a cavernous lymphangioma of the orbit with a cystic element. The history was that since birth a pea-sized lump had been present in the upper inner angle of the right orbit and that a gradual enlargement had taken place. A complete excision was carried out and the specimen when subjected to microscopic examination revealed a cavernous lymphangioma with a cystic element. There were large blood vessels in the connective tissue septae and the lymphocytic element was aggregated into follicles in some places.

Case 57 (Aged 11 years, fig. 22). This patient was first seen at the age of two years at which time he gave a history of congenital hemangioma involving the right upper lid nasally. He received injec-

Fig. 21 (Jones). *Case 53.* (A) Lymphangioma of the orbit, conjunctiva and lids present since birth (B) Side view of the same patient. Progression led to exenteration.

Fig. 22 (Jones). *Case 57.* (A) Lymphangioma of orbit, upper lid, and fornix shown early in its development. (B) The upper lid everted to show tumor mass in fornix. (C) The same patient following sclerosing solutions and surgery. (D) The patient is shown later in his course, following further surgery. (E) X-ray films of the orbits show an increase in all dimensions on the right, with an occluded adjacent frontal cell and change in the bone at the upper inner orbital angle. (F) The patient is pictured as he appeared following recent partial excision and plastic repair. (G) This is a second view taken recently to show that the ptosis is decreasing.

tions of sodium morrhuate beginning at about the age of one year and received CO_2 snow treatments to the skin. The original examination showed pigmentation of the skin of the right upper lid medially, thickening of the skin and large dilated vessels filled with blood in the upper fornix. The medial canthus was displaced somewhat downward and the globe was exotropic but not proptosed. It was felt that the mass extended posteriorly into the orbit. The original diagnosis was hemangioma of the right upper lid. The patient was admitted for plastic surgery but this was deferred because it was felt that nothing was to be gained. Several months later the patient was again signed in and a plastic procedure designed to elevate the lid was carried out but no excision of tumor tissue was done. X-ray films of the orbits showed the right to be greater in all dimensions than the left. There were no dehiscences. Three years later when the patient was aged five years, he was again sent in for a partial excision of this alleged hemangioma. At surgery the mass in the upper lid and orbit was found to be pulsating and to contain blood. A partial excision was carried out. The patient's recovery was uneventful although he reported that about once a month blood was on his pillow in the morning. Some further injections of sodium morrhuate were carried out. At the age of 11 years the patient was again admitted for partial excision of the tumor mass and a plastic repair was carried out. The lid was sacrificed in its medial five mm. and a dissection subconjunctivally of the tumor mass was also carried out. Bleeding was heavy and in some instances arterial. The tissues were scarred and the blood channels were large. Microscopic examination of the tissue removed at this time revealed it to be a typical lymphangioma of the cystic variety. The channels were large and irregular and contained an endothelial lining. There were lymphocyte aggregations in the surrounding tissue. The original lesion was either a lymphangioma or a combined lymphangioma and hemangioma, or a lymphangioma secondarily invaded by blood vessels either as a result of trauma or as the result of sodium morrhuate injections given early in life. The subsequent course was felt to be out of keeping with any known hemangioma in that the progress was slow but inexorable and refractory to treatment.

Although the course may continue to be one of slow progression, the present situation is the most favorable in cosmetic appearance and function that the patient has known.

Case 58 (Aged 20 years). Since the age of five years, the right eye protruded when he leaned forward. The exophthalmos was negligible erect but nine mm. when bending forward. X-ray films showed the right orbit to be larger. Partial excision of an orbital cystic tumor was done. The pathology report was lymphangioma. Seven months later further surgery was performed without improvement. Following this last procedure he had a residual proptosis which was increased when he bent forward and he felt that the condition was aggravated during a tour of parachute duty. Accordingly, in 1951, elsewhere, he had a transcranial approach to the orbit with excision of a portion of the tumor. Examination at the age of 28 years showed the eyes to be essentially normal except that the right eye, which was the affected eye, was less prominent than the left with the patient in the erect position. When the patient bent over for about 30 seconds the right eye developed eight mm. of exophthalmos which disappeared in one minute after the patient returned to the erect position.

Case 59 (Aged 15 years). At the age of four years excision of an orbital tumor was carried out. The diagnosis was lymphangioma. The patient was radiated, with good results, but the tumor recurred. At examination four mm. of left exophthalmos was

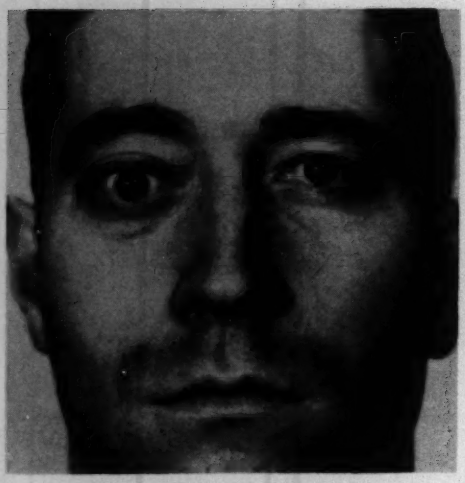

Fig. 23 (Jones). *Case 61.* Right exophthalmos due to orbital blood cyst in a lymphangioma.

present. A soft mass was felt in the orbit temporally. Fullness was present in the cheek. X-ray films showed a defect in the lateral wall at the sphenoid fissure. Additional treatment has not yet been carried out.

Case 60 (Aged 48 years). Ten years ago this patient had a lymphangioma of the conjunctiva and orbit on the left which was treated by injection. It subsided. One year ago there was a recrudescence of the lesion which subsided without treatment. The present episode was three months in duration. Sometimes the swelling showed hemorrhage and at other times not. A lump in the upper inner angle of the orbit had been present all his life. The mass had changed size from time to time. Examination showed a pedunculated red fleshy mass on the left semilunar fold and the fornix above and below. A rubbery mass in the orbit was palpable up and in. One mm. of exophthalmos was present. The clinical appearance at the last examination was that of hemangioma but the diagnosis had been proved to be lymphangioma by an earlier biopsy.

Case 61 (Aged 29 years, fig. 23). The patient had increasing proptosis of the right eye for two years. Weakness of the superior rectus and the superior oblique muscles developed. X-ray films showed atrophy of the orbital roof. At operation an orbital blood cyst was drained and partially excised. The microscopic examination showed a fibrous tissue wall without lining cells. The initial diagnosis was orbital blood cyst but further study showed the tissue to be compatible with a blood cyst in a cystic lymphangioma. This case was reported by Dr. John Wheeler[3] as an orbital blood cyst.

Case 62 (Aged 18 years, fig. 24). Since birth this patient has had a tumor in the medial half of the left brow. At the age of two years a partial excision, followed by radiotherapy, was done. Facial deformity resulted. At the age of 16 years, intermittent bleeding began from a red swollen upper lid. At the age of 18 years, tumor masses were visible or palpable on the hard and soft palate, the cheek, the brow, the lids, the conjunctiva and the lid margins. Exophthalmos was present. The lid margin lesions were wartlike. X-ray films showed an enlarged orbit. A biopsy through the lower fornix revealed endothelial-lined spaces containing clear fluid and nests of small blood vessels. The diagnosis was lymphangioma with postradiation blood vascularization.

Analysis of cases

The sixty-two cases presented here were divided as follows: purely conjunctival lymphangiomas accounted for 22 of the cases or approximately 35 percent; those involving the lids numbered 11 cases or 18 percent. This included those cases in which the lids and conjunctiva were both involved and also those cases in which the face and lids were both involved. The largest group in the present series numbered 29 and comprised lymphangiomas affecting the orbit. This amounted to 47 percent of the total. Included in this group were lymphangiomas affecting not only the orbit but also the lids, the conjunctiva, and the face in conjunction with orbital involvement.

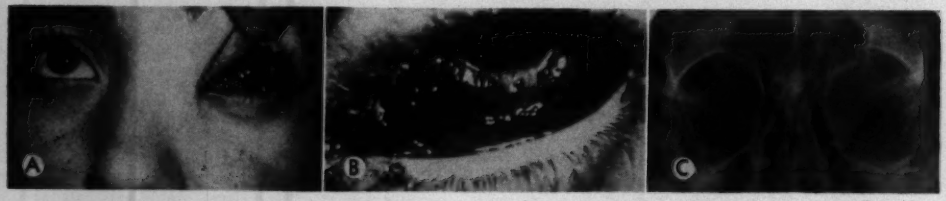

Fig. 24 (Jones). *Case 62.* (A) Lymphangioma of orbit, conjunctiva and lids, with prominent hemorrhagic element. (B) Wartlike tumors on the conjunctiva and lids. (C) X-ray film, showing orbital enlargement in the same case.

A. Conjunctival lymphangiomas

The conjunctival lymphangiomas were noted to be present at ages varying from birth to 65 years. The average age at which the conjunctival growths were noted was 25 years. The duration of the conjunctival tumors from the time they were first noticed until the time of excision, upon which this study is based, varied from two days to 12 years. The average duration was slightly over three years.

Sixteen of the 22 cases of conjunctival lymphangiomas occurred on the bulbar conjunctiva. Four cases occurred on the semilunar fold and inner canthal region, one case was at the limbus, and one was in the upper fornix. The presenting symptom in 16 of the 22 cases was the presence of a discernible mass or lump. Five of the patients complained of a red eye either recurrent or constantly present. One case had recurrent hemorrhages into an elevated area.

Although all of these cases were ultimately treated by excision, two cases had cautery preceding the final excision and one had unsuccessful aspirations attempted prior to the final excision (Case 9). One case had a partial excision performed three times prior to the total excision. Two of the cases had partial excision performed two times, and four cases had partial excisions performed one time prior to the total excision.

Microscopic examination of the excised tissues revealed one lymph cyst together with an epithelial cyst. The remaining 21 specimens were all cavernous lymphangioma. Two of these lymphangiomas were associated with lymphangiectasia. Case 1 (fig. 1) had a pigmented nevus in association with the lymphangioma. One of the cavernous lymphangiomas tended toward the cystic type. One was associated with an epithelial cyst, and one was associated with an epidermoid cyst of the limbus.

Follow-up information was not available in most of the cases. The present status of 17 cases is not known. Five cases had no recurrence at the most recent period of observation.

B. Lymphangiomas of the lids

This group was comprised of 11 cases. The age of onset of eight of these was birth. One was first noticed at one year of age and another at two years of age. A single case did not become apparent until adulthood. The average age of onset, therefore, was two years. The duration of the cases before treatment ranged from six months to 64 years. The average interval was approximately 13 years.

The lid area most frequently involved was the upper lid. Eight of the 11 cases involved the upper lid, two involved the medial canthal area, and one involved the lower lid. The commonest symptom was a slowly increasing mass. Six of the cases had this history. Two of the cases had masses which from time to time exhibited ecchymosis. One case had a mass which increased rapidly in size on straining, and a final patient was not appreciated to have a tumor until it became more prominent after a cellulitis of an adjacent portion of the tumor.

Six of the cases had complete excisions of the lymphangioma but one of these had previously had two partial excisions and another had previously had irradiation. Five cases were treated by partial excisions, three of these for the second or third time. One of the five had had sclerosing solutions injected into an adjacent facial lesion. X-ray films were not reported on any of these lid patients but one individual was noted to have a fossa in the bone at the time of surgery.

Microscopic examination of the tissue removed in all cases revealed cavernous lymphangiomas. Two of these had a prominent lymphocytic element with follicles being present in one. Another had large tortuous blood vessels in the lesion.

Follow-up information on most of the patients was sparse. One patient was definitely cured and one patient was not im-

proved by surgery. The remainder were improved in the early follow-up period but the final outcome was not recorded.

C. Orbital lymphangiomas

The age of onset in this group of 29 cases averaged 6.2 years. Ten patients had the lymphangiomas present at birth, 11 patients developed the disease in the period from birth to five years, and an additional five first showed the disease in the period from six to 15 years. One adult, aged 27 years, one aged 38 years, and one aged 44 years, first showed the lymphangioma at that time. The duration of symptoms from the time of onset until the treatment period upon which this study was based varied from nine days to 31 years, with the average being 8.3 years.

Thirteen of these orbital lymphangiomas were confined to the orbit. Eleven of the cases had, in addition to the orbital involvement, extension of the tumor to the lids or the conjunctiva. Five cases had lymphangiomas involving orbit, lids, conjunctiva, and face. Three of these five also had lymphangiomas of the palate. All of the patients had exophthalmos.

Six of the 29 cases had an intermittent exophthalmos or an exophthalmos which varied in amount from time to time. Of these six cases, two had an increase in protosis associated with coryza, one had an increase coincident with menses, one patient showed increased swelling associated with crying, and another patient demonstrated a postural increase by bending forward. Among the exophthalmos cases were six associated with ecchymosis or hemorrhage. One of these six cases had an external hemorrhage from the conjunctiva from time to time.

Four patients described an antecedent cause for the development of their proptosis. One patient was normal until an attack of hives, another developed exophthalmos after a blow to the brow, a third showed ocular lymphangioma only after cellulitis in a facial lymphangioma, and a fourth developed a rapid exophthalmos subsequent to a high fever.

The most common complication of orbital lymphangiomas was muscle imbalance. The five cases which exhibited this were distributed as follows: three showed an exotropia, one showed an esotropia, and one showed a weakness of the right superior rectus and the right superior oblique.

The next most common complication was ptosis of the upper lid. Two patients exhibited this. An additional two patients had a concomitant sinusitis which may have represented lymphangioma involvement of the affected sinuses. One patient showed a cellulitis in a facial lymphangioma apparently continuous with the orbital lymphangioma, and one patient had a radiation cataract as the result of X-ray treatment of the orbital lymphangioma.

X-ray films were available for study in 22 of the 29 cases of orbital lymphangioma. Sixteen showed an enlarged orbit on the affected side. Two of these 16 also showed sclerosis of the bone adjacent to the lesion and an additional two of these 16 showed a defect in the bone. Six patients showed no positive X-ray findings.

All of these cases were interpreted as cavernous lymphangioma of the cystic variety of cavernous lymphangioma after a study of the sections. Three, in addition, had hemangiomas associated with the lymphangioma. Eight of the patients had blood cysts in the cystic orbital lymphangioma spaces. Four patients had prominent blood vascular elements in the lymphangioma tissue. All of these with a prominent blood vascular element had received either sclerosing solutions or radiation or both at some earlier period in their treatment. Two patients interpreted as lymphangioma of the orbit had lost the endothelial lining of the lymphangioma spaces in the specimens examined.

Follow-up information on the patients revealed three presumably cured, 15 improved, seven unimproved, and four whose present status is not known.

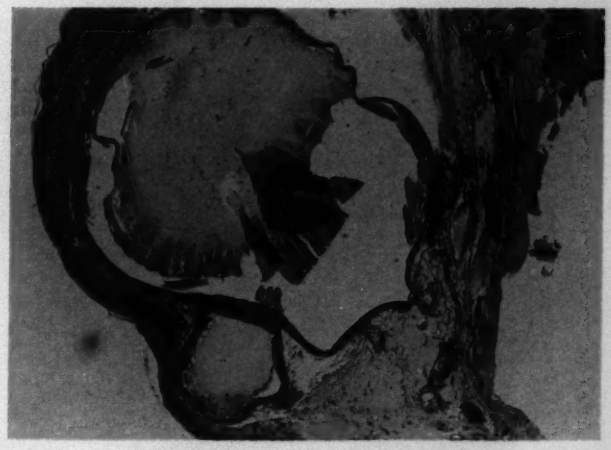

Fig. 25 (Jones). Lymphangiectasia. The simple dilation of a preexisting channel is in contrast to the ramified spaces of true lymphangiomas. This section in not from any patient reported here.

Pathology of lymphangiomas

The pathology of lymphangiomas as outlined in standard texts on pathology is applicable in general to the eye but the peculiarities in this region deserve attention. Conjunctival lymphangiomas grossly were small lesions in this series and most of them were subject to complete extirpation. Many of the lesions were so small as to escape detection until stasis produced a dilatation of adjacent lymph vessels and called attention to the lesion. These lesions often appeared to be clear conjunctival cysts.

Microscopic examination of conjunctival lymphangiomas showed them to be composed of small closely-packed endothelial-lined tubes lying in a very sparse stroma with a small or nonexist lymphocytic cell element. Some of the cases showed an adjacent endothelial-lined cyst, perhaps as large as the entire remainder of the lesion, which was lymphangiectatic (fig. 25) in nature. Case 22 (fig. 26) was, clinically, a solitary cyst.

The gross pathology of lymphangiomas involving the lids appeared less clear-cut than that of the conjunctiva. The lesions were poorly demarcated. Therefore, the gross specimens varied in size according to whether the specimen was a partial excision, a complete excision, or a complete excision with surrounding normal tissue.

Most of the lid specimens (fig. 27) were incomplete excisions done for purposes of establishing the diagnosis or in the course of

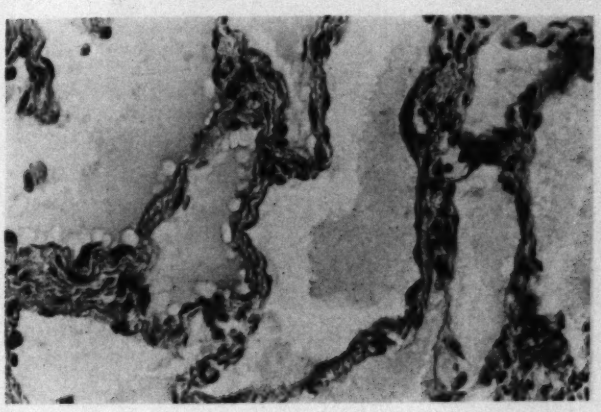

Fig. 26 (Jones). *Case 22.* This cavernous lymphangioma of the conjunctiva demonstrates fairly uniform spaces, delicate septae, an endothelial lining, and albuminous fluid in the space.

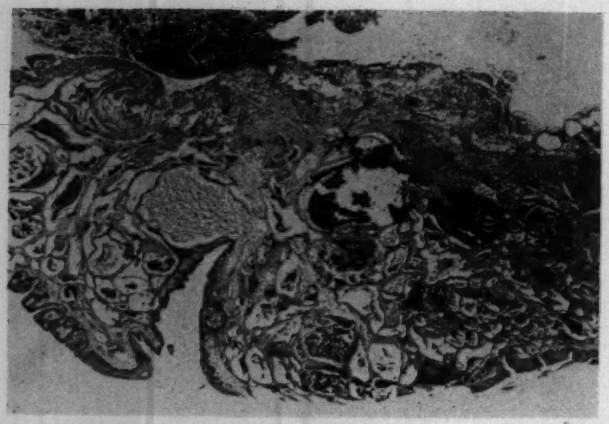

Fig. 27 (Jones). *Case 34.* This specimen is from the lid portion of a lymphangioma involving the orbit, lids and conjunctiva. It is noteworthy that almost all of the normal tissue has been replaced by the abnormal growth of a honey comb character. Several large blood channels are apparent.

a series of plastic surgical procedures. A striking feature in lid lymphangiomas was the variation in the amount of stroma.

Some cases, such as Case 34, showed the stroma almost entirely replaced by endothelial-lined spaces. Others showed scattered spaces in a heavy stroma. The endothelial-lined spaces tended to vary in size with smaller spaces lying near the surface and larger spaces being more deeply placed. The high-power section in Case 34 (fig. 28) illustrates this. The lymphocytic element also varied from a very little to a heavy amount aggregated into lymph follicles.

Extensive lymphangiomas of the lids in which the conjunctiva was also involved frequently showed prominent large blood vessels. These may have been the result of repeated hemorrhages and vascularization of a portion of the lymphangioma, or the result of secondary vascularization following treatment with irradiation or sclerosing agents. Case 57 was an example of the latter instance. It was noteworthy that those cases

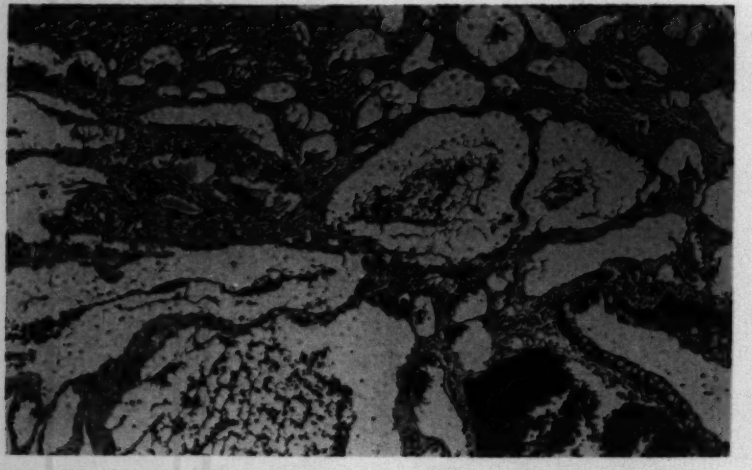

Fig. 28 (Jones). *Case 34.* A higher-power view of section shown in Figure 27. Note the great variation in the size of the spaces. Some of the spaces contain blood. The lymphocytic element is sparse.

Fig. 29 (Jones). *Case 37.* This orbital cystic lymphangioma demonstrates very large distensible spaces. There is a heavy lymphocytic infiltration. Some aggregations of lymphocytes project into the spaces as follicles. Many blood vessels lie in the septae, poorly insulated from the lymphangioma spaces.

with heavy lymphocytic follicular formation often had the follicles projecting into the lumen of the lymphangioma spaces as shown in the section of the orbital lymphangioma, Case 37 (fig. 29).

Orbital lymphangiomas were difficult to delineate as to gross pathology because they were nearly always cystic in some portion and the collapse of the cyst during surgery altered the gross appearance. If the cystic

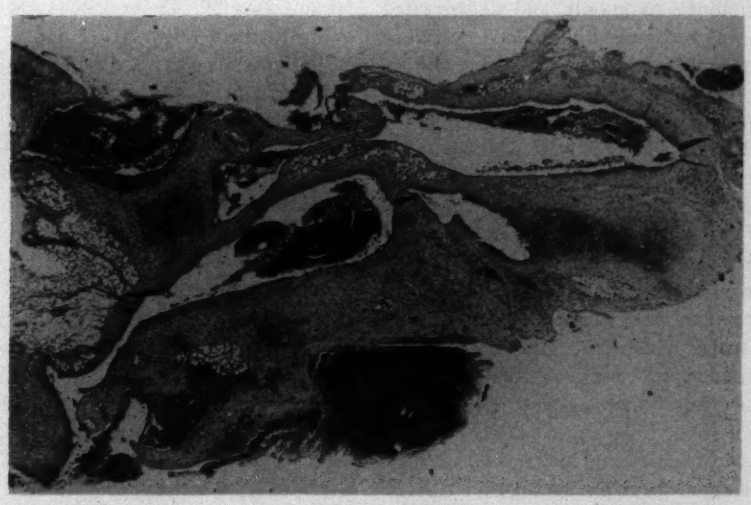

Fig. 30 (Jones). *Case 39.* This was an orbital lymphangioma of long standing which was unappreciated until hemorrhage into it caused a sudden proptosis. The spaces are large and some contain blood. The stroma is heavy. The lymphocytic infiltration is slight.

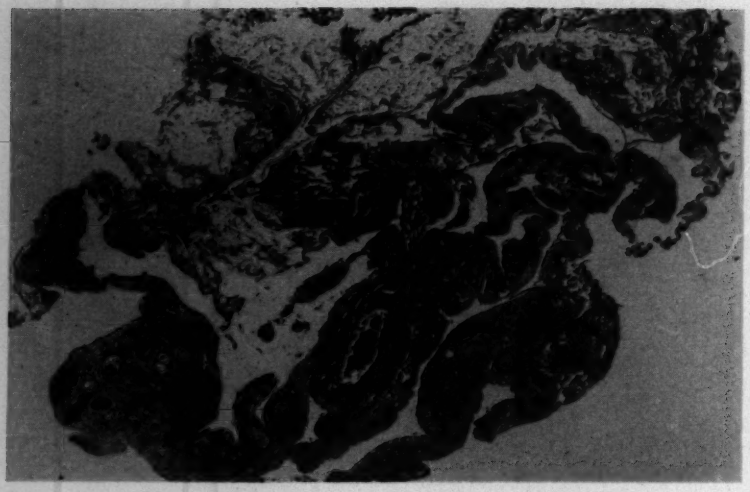

Fig. 31 (Jones). *Case 43.* This was an orbital cystic lymphangioma which contained old degenerated blood. The septae are quite thick and show lymphocytes aggregated into follicles. Large blood channels in close proximity to the lymph spaces are a prominent feature.

portion of the lymphangioma did not contain blood, then the swelling was often not recognized until the cyst was inadvertently opened. At this time clear or straw-colored fluid escaped. If the lesion contained new blood or, more commonly, old degenerated blood, it was recognized as a blood cyst very early but could seldom be removed without breaking the cyst. Accordingly most of the gross specimens of orbital lymphangioma consisted of a section or cyst wall.

In the case in which exenteration of the orbit was done, the lymphangioma appeared to lie in close proximity to the short posterior ciliary vessels. Microscopically the lymphangioma spaces were characterized by large irregular size. Portions of the lesions showed spaces which fell in the size category of cavernous lymphangiomas but there was usually a cystic lymphangioma portion. The amount of stroma was quite variable and the proportion of lymphangioma space to stroma was difficult to ascertain because of the collapsed nature of the space.

Large blood vessels poorly supported near the endothelial lining were a common feature. Degenerated blood and blood pigment often appeared in the spaces and in the tissues comprising the wall of these lymphangiomas. The lymphocytic element was extremely variable but heavy infiltration with follicle formation was common. The sections from Cases 39, 43, and 48 show the foregoing features (figs. 30, 31 and 32).

The pathology of lymphangiomas gives nothing which is invariably characteristic of these lesions and not found in any other condition. The picture is most often confused with hemangioma. If the spaces previously described are found to contain red blood cells, often this is taken to indicate it is a hemangioma.

If the spaces are small and inconspicuous and the lymphocytic element is large, then there may be a diagnosis of nonspecific granuloma. In those instances in which the endothelium has been lost from the lining spaces and in which old degenerated blood is present, the diagnosis of blood cyst or organized hematoma is frequently made.

In general, the presence of variable-sized endothelial-lined spaces without a capsule and containing lymphocytes in the stroma is suggestive of lymphangioma. The clinical

course is more characteristic of the disease than is the pathology and when taken in conjunction with the microscopic findings is usually sufficient to establish the diagnosis. Peters[3] and Reese[1] have described the pathology of lymphangiomas of the ocular adnexae.

Diagnosis

Inspection of a tumor of the ocular adnexae is often sufficient to recognize it as a lymphangioma. If there is a conjunctival portion, magnification with the slitlamp and corneal microscope may make the diagnosis more certain.

Nearby lymphangiomas of the face, nasal cavity, paranasal sinuses, or palate may suggest the nature of a similar lid or conjunctival swelling.

The clinical behavior of the lesion, especially inexorable slow progression during the growing years, is characteristic of lymphangiomas.

Complications are often a clue to the diagnosis of lymphangioma. Repeated hemorrhage into the suspected lesion is in keeping with a lymphangioma diagnosis. Cellulitis, either with or without a concurrent upper respiratory infection, is another characteristic complication.

Refractoriness to treatment is a feature which should be counted in favor of the diagnosis of lymphangioma.

Biopsy of the lesion and examination of the tissue under the microscope may give a positive diagnosis. In those cases in which the pathology alone is not pathognomonic, often when taken in conjunction with the clinical picture the combination will be diagnostic.

X-ray examinations frequently furnish corroborative evidence. If there is a facial lymphangioma there will be asymmetry. If the orbit is involved, most cases will show enlargement and increased volume.

Orbital lymphangiomas without lid or conjunctival involvement probably can only be suspected but not diagnosed until the orbit is opened at surgery. The finding of a blood cyst raises the suspicion of a cystic orbital lymphangioma, and the microscopic examination of the cyst wall will often confirm this.

The differential diagnosis of lymphangi-

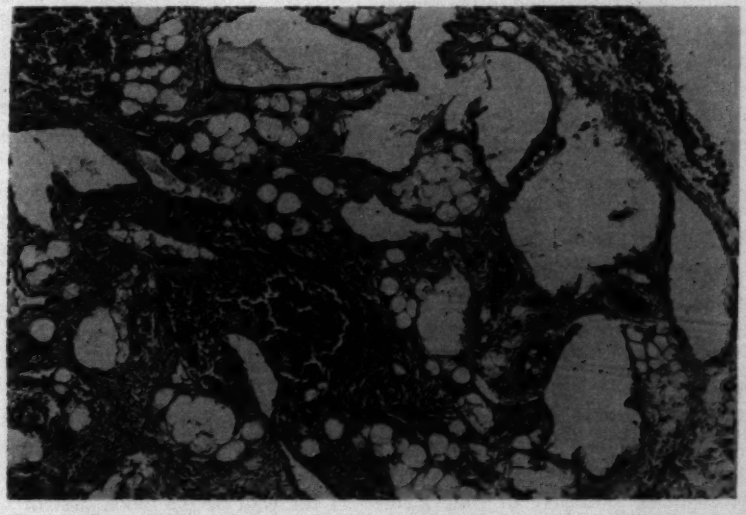

Fig. 32 (Jones). *Case 48.* This case was grossly a blood cyst of the orbit, which proved to be lymphangiomatous. The specimen shows a moderate stroma containing many small spaces. Lymph follicles can be seen. The endothelial lining has been lost in many areas.

TABLE 1

COMPARISON OF CHARACTERISTICS OF LYMPHANGIOMAS AND HEMANGIOMAS*

	Lymphangiomas	Hemangiomas
Onset	Birth	Birth
Course	Slow progression	Rapid progression
Regression	Does not occur	Occurs between the age of one and five yr. (Benign hypertrophic hemangioma of infancy)
Complications	Hemorrhage Cellulitis	Thrombosis
Radiosensitivity	Low	High (Benign hypertrophic hemangioma of infancy)
Capsule	None	Present in cavernous orbital hemangiomas

* The information regarding hemangiomas is taken from Reese.[1]

oma of the ocular adnexae concerns chiefly one other similar tumor, namely hemangioma. By inspection, lymphangiomas may appear identical to hemangiomas. In some patients mixed lymphangiomas and hemangimas occur (Case 34). Lymphangiomas, especially after irridation or the use of sclerosing solutions, may exhibit large blood vessels of a racemose character (Case 57). Specimens removed for microscopic study often contain adventitious blood in the lymph spaces and confuse the pathologist between lymphangioma and hemangioma. The most reliable differential between these two conditions is the clinical course. Table 1 compares some characteristics of each disease.

Treatment and Prognosis

Treatment

Conjunctival lymphangiomas which present as clear cysts are often punctured and disappear temporarily. They usually recur, however. Since the limits of conjunctival lymphangiomas can be observed by inspection, it is usually possible to excise the entire lesion. The large number of apparent cures in the conjunctival lymphangioma cases presented herewith is indicative of this. Lymphangiomas involving the lids are less well defined and less susceptible to complete excision. Adrenal steroids have been used with improvement in elephantiasis of the lids but it is not clear how large a proportion of the lesion was inflammatory or how great a portion was lymphangiomatous. Sclerosing solutions have been tried with improvement but the present group of cases contains no satisfactory results after sclerosing solutions and no instance of a cure could be found in the literature.

X-ray and radium therapy likewise have been tried with improvement and likewise have failed to give entirely satisfactory results. In addition, the adverse effect of radiation upon orbital bone growth in a young individual limits the usefulness of this approach. It has been stated by Walsh[4] that lymphangiomas are exceedingly radiosensitive. Reese,[1] however, takes the view that lymphangiomas are resistant to any treatment except complete excision. Since these tumors are slow-growing, repeated partial excisions and plastic repair over a period of years may gradually get ahead of the tumor and lead to a satisfactory result as in Case 56.

Orbital lymphangiomas, particularly those associated with bleeding into the spaces, form a separate category regarding treatment. If the orbital lymphangioma is susceptible to striking increase in size with inflammatory symptoms coincident with upper respiratory infection, then the anti-inflammatory measures employed against the respiratory infection will often be equally efficacious against the exophthalmos.

Recurrent exophthalmos, together with ecchymosis, indicates hemorrhage into the lymphangioma spaces which often absorbs spontaneously. Occasionally, however, the hemorrhage into the orbital lymphangioma is followed by a slow steady increase in exophthalmos, lasting several months. This may be due to the breakdown of blood and the imbibition of fluid in a manner similar to that which occurs in chronic subdural hematomas. These latter cases sometimes do well if the wall of the blood cyst or of the lymphangioma is widely opened, allowing the lesion to collapse. Even though a complete excision is not carried out, the proptosis

frequently does not recur (Cases 38 and 57).

The treatment of lymphangiomas in general is not urgent since these tumors are benign and slow growing. Complete excision should be carried out when possible but repeated partial excisions may be satisfactory. Drainage of blood cysts may be efficacious and anti-inflammatory measures, when indicated, are useful. Probably radiation and sclerosing solutions should not be used.

Prognosis

The prognosis for lymphangiomas depends upon the size of the lesion. Although the disease is present at birth, many of the smaller conjunctival lesions are not apparent until years later, at which time they may be completely excised. Somewhat larger tumors may be noted early in life but may require intervention only after years of growth. Partial or piecemeal excision may be satisfactory, as in Case 57. The prognosis for a cure is poor unless the lesion is small enough to be completely excised.

The absence of any middle-aged or elderly patients still undergoing treatment for lymphangiomas in the present series suggests that the progression of these lesions ceases early in adulthood. Large lymphangiomas such as Case 49 and Case 53 may require exenteration.

The prognosis of orbital blood cysts in lymphangiomas appears to be good even without treatment, as shown by the cases in the present series with recurrent exophthalmos and spontaneous subsidence. Removing a portion of the cyst wall seems to be curative.

General discussion

The foregoing analysis of 62 cases of lymphangioma shows these lesions to be benign and usually to be congenital. A good proportion of the smaller lesions, especially those of the bulbar conjunctiva, did not become apparent until later in life but the supposition is that some small beginning was present at birth.

The division of lymphangiomas into "capillary" and "cavernous" does not seem to have much meaning, since the clinical course is the same. Designation of the cystic variety of cavernous orbital lymphangioma does indicate a clinical picture often associated with blood cysts of the orbit. Lymphangio-endotheliomas were not encountered in the foregoing cases, and no comment can be made except that they are rare. The term elephantiasis is confusing when used to include lymphangiomas and probably should not be used once the diagnosis is made. Support could not be found in the cases here analyzed for a nomenclature paralleling that of hemangiomas.

The calculations regarding incidence of lymphangiomas are an approximation. It is probable that lymphangiomas of the ocular adnexae and face are relatively more numerous in hospital records than those of other parts of the body because their exposed position leads the patient to seek attention for cosmetic reasons.

The case reports in this paper are all based upon microscopic examination of tissue specimens. Those cases in which complete excisions were performed and the patient was cured have largely been lost to follow-up since the patients often did not return. A few of the cases presented herewith have been reported elsewhere and this is noted for each case. They are included here in order to make a complete report of all cases in the institution. As many of the cases as could be examined clinically were seen. All of the available microscopic specimens were examined. Some specimens were seen by several pathologists. If diagnosis varied, then that one which best fitted the clinical features was selected. The division of cases into three groups was on the following basis:

Conjunctiva: only conjunctival involvement.
Lids: lids either with or without involvement of conjunctiva or face.
Orbit: orbit either with or without involvement of conjunctiva, lids, or face.

The proportion of orbital lymphangiomas shown in this analysis of cases is surprising. Almost half of the cases involved the orbit.

It may be guessed that the rapid development of proptosis, as was the case in many of the orbital lesions, was more likely to lead to surgery than a long-standing easily visible lid or conjunctival lesion.

The detailed analysis of these cases need not be repeated but it is perhaps worthwhile to comment on the variations from the usual slow steady progression encountered in lymphangiomas. The perusal of the hospital records in cases of lymphangioma elsewhere than the ocular adnexae shows the most common complication to be cellulitis. Some of the cases reported here also showed cellulitis often associated with coryza. This clinical observation coupled with the appearance of heavy lymphocytic infiltrations in microscopic preparations leads to the speculation that the cellulitis might represent a rapid heavy round-cell infiltration.

The second variation is spontaneous hemorrhage into a lymphangioma. This causes a sudden swelling and redness. The absorption of the hemorrhage may lead to neovascularization so that in time the lymphangioma comes to resemble a hemangioma. Cystic orbital lymphangiomas may spontaneously fill with blood, but more often do so after trauma. The association of trauma with an orbital blood cyst may lead the surgeon to drain the cyst without removing the wall for study. Possibly some cystic lymphangiomas are undiagnosed for this reason.

Although the pathology of lymphangiomas has been described, two features deserve comment. One is the presence of large poorly supported blood vessels close to the lymphangioma spaces. These vessels look prone to hemorrhage into the lymphangioma spaces. Since such a happening is common, I believe it to be a result of the precariously placed blood vessels. The second feature to be emphasized is the presence of lymphocytes, often aggregated into follicles and surrounding the lymph spaces. This may explain the controversial treatment effect.

The treatment has already been discussed and excision has been named the most effective. One of the cases presented improved on irradiation and later had surgery. Others did not benefit from irradiation. References are cited claiming radiosensitivity and radioresistance. It may be suggested that those cases with a heavy lymphocytic infiltration would benefit from irradiation since it is common knowledge that round cells respond well. Once the infiltration was reduced, improvement would cease.

The literature gives little help regarding the eventual outcome of lymphangiomas of the ocular adnexae and the present series of cases also does not give the end-result. The positive evidence is that cases in some adults are unchanged or little changed after the patient reaches adulthood (Cases 41 and 58). The negative evidence is that few middle-aged or elderly adults are represented in this series. I believe that the slow progression of lymphangiomas of the ocular adnexae ceases when growth ceases and the lesions thereafter remain stationary.

Summary

There has heretofore existed no full delineation of the character of lymphangiomas of the ocular adnexae. This paper is such a delineation based upon a review of the literature and an analysis of 62 cases, the largest series yet reported. The most interesting conclusions are:

1. Lymphangiomas are congenital, benign vascular tumors characterized by slow progression.

2. They differ from infantile hemangiomas in the absence of a hypertrophic phase followed by spontaneous regression.

3. Hemorrhage into lymphangiomas with or without trauma is a characteristic complication.

4. Actual infection or lymphocytosis concurrent with upper respiratory infection is common.

5. Cystic orbital lymphangiomas play a dominant role in the genesis of orbital blood cysts.

6. The mechanism of orbital blood cyst production may be identical to that of chronic subdural hematoma production.

7. Lymphangiomas are not radiosensitive.
8. The treatment of choice is excision.
9. The diffuse borders of these tumors and the lack of a capsule make complete excision difficult.
10. Small lymphangiomas respond well to treatment.
11. Large lesions are resistant to treatment.
12. The progression of lymphangiomas becomes slower as general growth slows and a stationary point is reached in early adulthood.

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TOBACCO AMBLYOPIA*

Clinics in Perimetry No. 4

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Although tobacco amblyopia is a relatively unusual disorder, its possibility must be kept in mind by the perimetrist when confronted with a patient who has failing central vision not explainable by ophthalmoscopy. The scotomas of this disorder are so characteristic that once they have been demonstrated, little doubt regarding their etiology remains.

Tobacco amblyopia is considered as a toxic amblyopia. It is at times associated with excessive alcohol consumption and poor nutrition, and it seems to occur more commonly in diabetics. However, unless tobacco is a factor, the scotomas remain central rather than cecocentral. It is our experience that tobacco amblyopia occurs in cigar smokers, rarely in pipe smokers and never in cigarette smokers.

The disease is always bilateral and of about equal severity in the two eyes. Its onset is insidious over a period of weeks and even months, and the patient becomes unable to read any but the largest print. The disease does not progress after this stage is reached, even if the true nature of the etiology is not appreciated and the smoking is continued. The scotomas are usually cecocentral with the densest area between the fixation point and the physiologic blindspot.

Typical cases

Case 1

A 57-year-old man was seen at the Mayo Clinic on January 7, 1957, because of blurred vision of approximately one year's duration. He said that his vision had become worse over the preceding six weeks and that it prevented him from reading ordinary newspaper print. His ophthalmologist had referred him to his general physician who had found sugar in his urine and a value for blood sugar of 186 mg. per 100 cc. He was placed on a diet, and in four days his urine was free of sugar and the blood sugar measured 76 mg. per 100 cc.

General examination at the clinic revealed a value for blood sugar of 96 mg. per 100 cc. and no glycosuria. He was still bothered some by chronic ulcerative colitis, this having been a previous complaint when he had been seen at the clinic in 1948.

His vision was recorded as 20/200 in the right

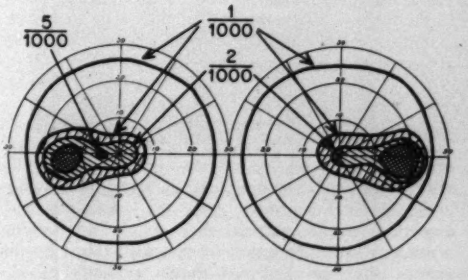

Fig. 1 (Rucker and Kearns). Typical of cecocentral scotomas of tobacco amblyopia in *Case 1.*

* From the Section of Ophthalmology, Mayo Clinic and Mayo Foundation. The Mayo Foundation, Rochester, Minnesota, is a part of the Graduate School of the University of Minnesota.

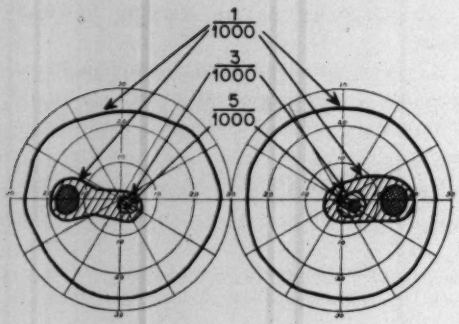

Fig. 2 (Rucker and Kearns). *Case 2.* Cecocentral scotomas of tobacco amblyopia.

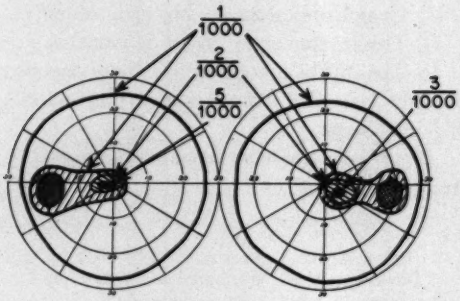

Fig. 3 (Rucker and Kearns). *Case 3.* Cecocentral scotomas of tobacco amblyopia.

eye and 20/400 in the left eye. The results of ophthalmoscopic examination were normal. It was noted that the discs were normal in color. His visual fields, as plotted on the tangent screen, are shown in Figure 1. He admitted that for some years he had smoked a number of cigars a day, apparently more than he liked to admit. He insisted that he took only an occasional social drink and that he had been eating well.

CASE 2

Because of failing vision of five months' duration a 61-year-old man registered at the Mayo Clinic on May 4, 1956. Twenty years previously he had begun to take an occasional social drink. For the last four to five years he thought that he had averaged about a half pint of whiskey daily. For many years he had smoked eight to 10 cigars a day.

Results of his general examination were essentially normal except for a slight tremor of his right hand which he stated had been present for four months. No evidence of diabetes could be found and the value for fasting blood sugar was well within normal limits. Neurologic consultation revealed a slight sensory loss in the lower extremities that was more advanced peripherally. His cerebrospinal fluid was normal and it was the impression of the neurologist that the patient had peripheral neuritis.

Examination in the Section of Ophthalmology showed a vision of 20/60 in the right eye and 20/70 in the left eye that could not be improved by lenses. Examination of the ocular fundi did not show any abnormality (fig. 2).

CASE 3

A 61-year-old man was seen on July 21, 1958. In January, 1957, he began to notice blurred vision. Over a three-week period this progressed rapidly without headaches, pain in the eyes, or other symptoms. He had consulted three eye specialists and, according to the patient, they could find nothing wrong. A roentgenogram of the skull taken by his family physician had not shown evidence of abnormality. On questioning, he admitted that he had smoked six cigars daily for 40 years. He stated that he did not use alcohol.

The results of general examination were negative. Vision of the right eye was 20/100 and that of the left eye was 20/400. Mild pallor of each optic disc was noted with the ophthalmoscope and central vision could not be improved with lenses. Cecocentral scotomas were demonstrated on the tangent screen (fig. 3).

All three of these patients were advised to give up tobacco. In the applicable cases the patients were warned against further use of alcohol. Multiple vitamins in therapeutic doses were recommended. The prognosis generally seems to be related to the duration of the trouble. If visual loss has been present for only a few months, vision is likely to return to normal if the patient stops smoking; if longer, the outlook is less favorable.

SUMMARY

Three cases of tobacco amblyopia encountered at the Mayo Clinic are presented. Visual fields of each case demonstrated the characteristic bilateral cecocentral scotomas with a relatively dense core between the point of fixation and the physiologic blindspot. Tobacco amblyopia is one of the few disorders in which the diagnosis may be made from the characteristics of the visual fields alone. However, as with all defects of the visual fields, the perimetrist must first plot the defect carefully and then properly interpret the findings.

Mayo Clinic.

NOTES, CASES, INSTRUMENTS

ADHESIONS OF THE LENS CAPSULE*

TO THE ANTERIOR HYALOID MEMBRANE

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In the recent literature Vail[1] and Reese and Wadsworth[2] demonstrated the existence and emphasized the clinical significance of adhesions of the lens to the anterior hyaloid membrane in the normal human eye. They reviewed the older literature on this subject and also discussed the great importance of these adhesions in cataract surgery. This short paper is an addition to the excellent discussions of these authors. It seems to me that the present case verifies all that they have said in a very impressive way.

It is routine in this Eye Clinic to have two donor eyes available for every corneal transplantation. Usually only one of these eyes is used. The other eye is utilized for research. I had become interested in the mechanics of cataract extraction and repeated with several such eyes the experiments described by Reese and Wadsworth.[2] No additional findings were observed until I started to work with the eye that is reported in this paper.

CASE REPORT

This 50-year-old white man had died on September 2, 1959, with the diagnosis of a brain tumor. This was pathologically verified to be a massive astrocytoma of the left central hemisphere. His eyes had been normal until death except for some papilledema, O.U. His vision was recorded as normal and his pupils were equal and reacted well to light. It must be mentioned, however, that the ocular examination was done by a neurologist and that the patient was not seen by an ophthalmologist. The patient donated both eyes to the Eye-Bank of the University Medical Center (Michigan Eye Collection Center). The eyes were removed a few hours after death. A corneal button from the left eye was used for a corneal transplant. The right eye became available for my studies.

This right eye appeared externally normal and had a clear cornea and normal anterior chamber. The iris was dilated and the lens was clear. The whole cornea was removed by a corneoscleral section all along the limbus. When I then tried to remove the lens it became obvious that the lens was firmly attached to the vitreous body. It was actually possible to lift a part of the anterior vitreous out of the eye after the zonular fibers had ruptured all around. At this stage a few

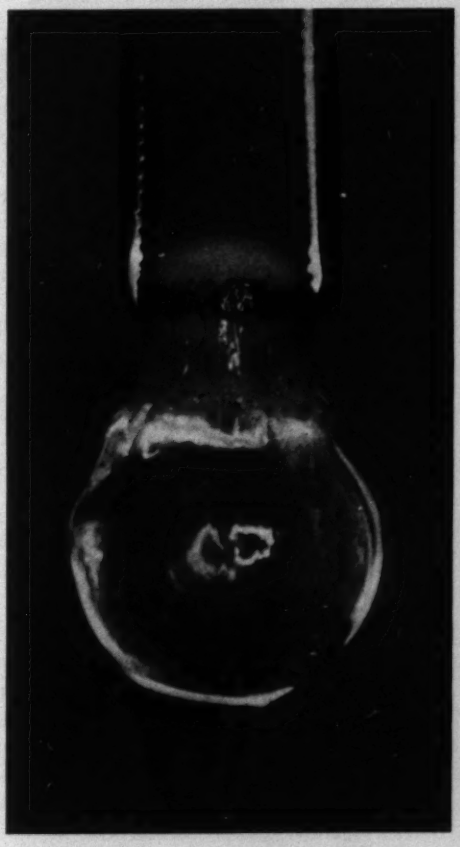

Fig. 1 (Wolter). Photograph of whole vitreous body hanging on posterior lens surface. Pigment and parts of peripheral retina are attached to the periphery of the vitreous body. Formed vitreous is protruding through the posterior opening of Cloquet's channel. The preparation was kept in formalin until the photograph could be taken.

* From the Department of Ophthalmic Surgery of the University of Michigan Medical Center.

radiating cuts were carefully made into the sclera starting at the limbus. After this the whole intact vitreous body could be slowly pulled out of the eye by pulling only on the lens.

Figure 1 shows the lens with the vitreous body hanging on its posterior surface. Both, the lens capsule and the hyaloid membrane had remained intact. Some pigment and parts of the peripheral retina can be seen attached to the anterior peripheral vitreous body. The posterior opening of the channel of Cloquet in the area of the disc is also well visible in the photograph because of the prolapse of formed vitreous through it. The threadlike structure of a persistent hyaloid artery was seen in the posterior part of the vitreous with a dissecting microscope. The vitreous was otherwise perfectly clear.

The remaining shell of the eye—retina, ciliary body, choroid, sclera—was fixed, sectioned and studied histologically. It was found completely normal except for some damage to the ciliary body and the peripheral retina. No evidence for papilledema was seen in our slides.

This eye demonstrates how firmly the posterior lens capsule may be attached to the anterior hyaloid membrane. The existence of a persistent hyaloid artery in this eye suggests the explanation that there was also a persistence of "embryonic fibers joining the posterior lens caspule to the anterior hyaloid" (Vail[1]) which caused the firm connection in this case. The clinical importance of this observation is that an eye surgeon would not be able to see the persistent hyaloid artery in such a patient if he came with an advanced cataract. Only the knowledge of the possibility of the occurrence of such extensive adhesions in normal-appearing eyes and their management (Vail[1] and Reese and Wadsworth[2]) could save him from major complications at surgery.

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A NEW TECHNIQUE FOR CUTTING LAMELLAR GRAFTS*

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Although lamellar keratoplasty is a less radical procedure than the pentrating graft, it is generally considered to offer significant technical difficulties. Unless one performs the operation frequently, or practices beforehand, it is not easy to maintain an even plane of cleavage and one may traumatize the button considerably while dissecting it.

This was true in most of the older methods of dissecting lamellar grafts—the knife dissection with a preplaced suture for traction, the scissors dissection and most variations on these techniques. More recently Castroviejo designed an electric keratotome which produced a much smoother donor graft and had every advantage except simplicity.

The method described here was conceived when it was realized how readily the cornea can be separated into layers. It was found that a very simple technique produced an amazingly smooth dissection.

METHOD

There are essentially only four steps:

1. A small (three to four mm.) incision is

* From the laboratory of The Eye-Bank for Sight Restoration, Inc., Manhattan Eye, Ear and Throat Hospital.

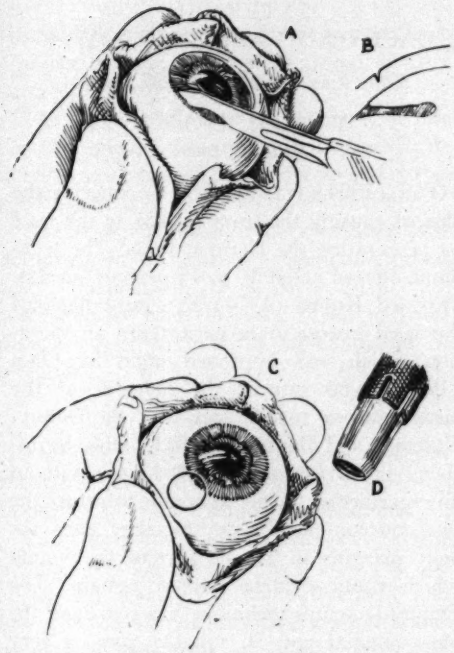

Fig. 1 (Martinez). An initial incision to the desired depth of the lamellar graft is made just inside the limbus.

made just inside the limbus and parallel to it. The incision may be made with any type of knife (fig. 1-A and B) or with a corneal trephine (fig. 1-C and D) and should be as deep as the desired graft.

2. With a corneal dissecting knife* (fig.

* The knife pictured is Troutman's design made by Storz.

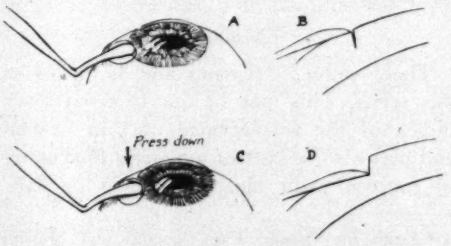

Fig. 2 (Martinez). Using a corneal dissecting knife the scleral side of the incision is depressed and the blade is inserted between the corneal lamellae at the desired depth.

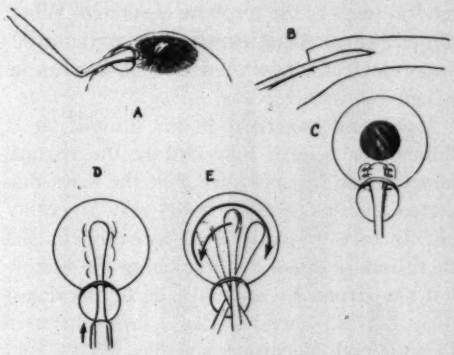

Fig. 3 (Martinez). Small, circular movements are used to create a pocket (A, B, and C). Then the blade may be advanced across the cornea (D) and swept from side to side (E).

2) the peripheral edge behind the incision is depressed and the blade is inserted at the desired level using small, circular movements until a pocket is formed.

3. As soon as the blade has created a pocket in the proper plane of cleavage, it may be advanced across the cornea and swept from side to side until almost all of the cornea has been undermined. The blade will stay in the proper plane without trouble (fig. 3).

4. The blade is then withdrawn (fig. 4-A and B) and the trephine is applied at the center of the cornea (fig. 4-C). Since the cornea is still attached at the limbus an even tension is preserved and the cornea does not

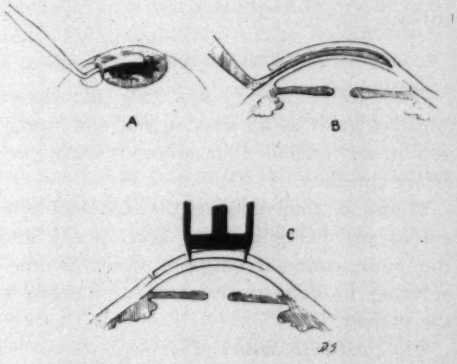

Fig. 4 (Martinez). The entire cornea is undermined in this manner (A and B). A trephine is then used to cut the lamellar disc (C).

tend to twist as the trephine is rotated. When the cut is complete the trephine is removed, and a perfect, smoothly dissected disc can be lifted free with forceps.

Until one has tried it for himself, it is difficult to believe how cleanly the corneal lamellae can be separated, but the discs dissected by this method were very smoothly cut. In fact, they can be so smoothly cut that there is a problem distinguishing the epithelial side from the stromal side of the donor disc. Dr. R. Townley Paton, after he used this method of cutting lamellar grafts, suggested that one might stain the cornea with methylene blue before cutting the disc, to eliminate any possibility of confusion.

When this technique was demonstrated for Dr. Joseph Baldone of New Orleans, he suggested using a trephine with the inside guard set at the desired depth to make the initial incision near the limbus, as shown in fig. 1-C and D. This has the advantage of controlling the depth of the cut more exactly. A Paufique knife can be used to undermine the edge of the cornea until a plane of cleavage is established; then a blunt spatula is inserted between the layers to complete the undermining, using the sweeping motion already described. Dissection with a blunt-edged spatula is more difficult because it essentially pries the layers apart, rather than cutting them apart, but it is interesting that it can be done, and it leaves a very smooth surface.

Conclusion

This technique of dissecting the donor lamellar graft is an easy, quick and nearly fool-proof method. It produces smooth, perfectly cut discs.

It may be that reducing the technical difficulties will bring lamellar keratoplasty into the more common usage it deserves, considering its comparative lack of danger to the patient.

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EXTERNAL DACRYOCYSTORHINOSTOMY*

Clinical review of 56 cases

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Toti (1904) was the first to conceive the idea of causing the tears to pass to the nose by perforating the lacrimal fossa. The technique offered about 10 to 15-percent success. This led Kuhnt (1914) to suture flaps of the nasal mucosa to the periosteum, an operation which was improved upon by Ohm (1920), who sutured the margins of the nasal mucosa to the sac, and by Dupuy-Dutemps and Bourguet (1921) who, by incising the posterior wall of the sac without any sacrifice of tissue, were able to suture the two mucous membranes together over the bony margins so that no part of the wound which could cicatrize would remain. The Dupuy-Dutemps technique has remained the most popular and, in suitable cases, a very high percentage of functionally good results can be obtained.

I have recently undertaken the study of dacryocystorhinostomy by the external route and it is the purpose of this paper to present the results of the 56 operations performed.

The clinical material for this study was those cases admitted to Gandhi Eye Hospital with the diagnosis of chronic dacryocystitis or lacrimal obstruction, in which there could be adequate follow-up to determine success or failure.

Etiology

There were 39 females and 17 males in this series. This may be due to a narrower lumen of the nasolacrimal duct in women and may also be part of a general thickening of mucosa, with muscular atonia or flab-

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* From the Gandhi Eye Hospital and Muslim University Institute of Ophthalmology. I am grateful to the Chief Medical Officer, Gandhi Eye Hospital, for permission to undertake this study and publish this paper.

biness. It has been claimed that females have a higher orbital index and so are much more susceptible to the disease.

The age distribution of patients at the time of operation is shown in Figure 1, the average age being 25 years; the youngest was aged five years and the oldest 44 years.

The probable cause of dacryocystitis was unknown in 35 cases; congenital in two cases; traumatic in three cases. Five cases were due to sinus disease; seven to nasal disease; four to external inflammation or infection.

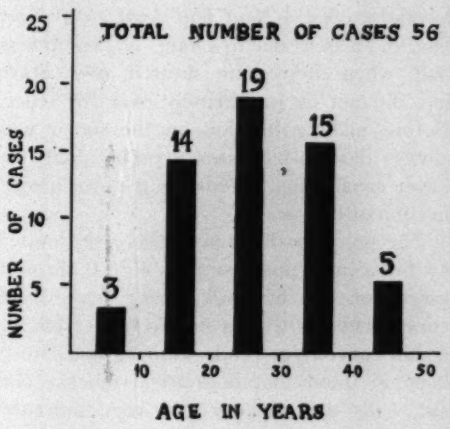

Fig. 1 (Dayal). Age distribution in 56 cases.

Technique

The technique used in the present series was essentially that of Dupuy-Dutemps and Bourguet with only minor modifications.

Local anesthesia was preferred in adults because (1) bleeding is much less, (2) the anesthetist is out of the operative field, and (3) the usual postoperative complications of general anesthesia are eliminated. Sedation was effected by a mixture of chlorpromazine, phenegran, and pethidine given intramuscularly one and a half hours before operation. In children and some adults general anesthesia had to be used. Local anesthesia was achieved by infiltration of the area over the sac with two-percent procaine and adrenalin 1:5,000, two to three minims per cc. The supraorbital, supratrochlear, infratrochlear and infraorbital nerves were blocked. A pledget saturated with four-percent cocaine and adrenalin was packed in the middle nasal meatus. The packing was left in position for about 10 minutes.

Operative procedure. A generous crescentic incision, more than an inch in length to give operative ease, was made two to three mm. from the inner canthus to avoid the angular vessels. A rhinostomy lamp was used before the operation to help mark the outline of these vessels on the skin. The medial palpebral ligament was incised. The medial wall of the sac and periosteum were reflected, exposing the lacrimal fossa. Care was taken not to penetrate the postlacrimal fascia, thus avoiding herniation of orbital fat. The sac was held laterally by means of a flat retractor.

Again the rhinostomy lamp was used to indicate the area of maximum luminosity, the elected site for the bony excision. A chisel and hammer were used for opening and bevelling, making the bone easier to lift out. One should remember that, in the posterior portion of the fossa, the lacrimal bone is thinnest. The opening was enlarged by a Citelli punch to admit a finger easily. It is better to place the opening anteriorly and inferiorly rather than above. An anterior opening will avoid disturbing the ethmoidal labyrinth and the inferior position avoids the complication of an accumulation of drainage material in the lower portion of the sac. The opening should extend downward at least to the beginning of the nasolacrimal duct. The rhinostomy lamp was also helpful at this stage to confirm if the nasal bony wall had been removed completely before the incision of the mucous membrane was made.

Oozing of blood was usually well controlled by means of pledgets of cotton-wool soaked in adrenaline 1:10,000. A vertical I-shaped incision was made into the exposed nasal mucosa and the medial wall of the sac. As far as possible the incision was asym-

metric so that a long flap went to a short one, and a short one to a long. The result was that, when these were sutured, one suture line did not lie immediately over the other. Before making incision on the sac it was always desirable to pass a probe along the lower canaliculus in order to confirm identification of the sac.

The posterior flaps or panels were united by three interrupted sutures of 6-0 chromic catgut or 6-0 fine silk, using very small curved needles with a needle holder having a thin curved tip. While suturing one should keep in mind that both nasal mucosa and sac walls are slippery and very thin and fragile.

After suturing the posterior flaps, a three-mm. lumen polyethylene tube was passed through the sac and out in the corresponding naris. This was secured to the anterior leaf of the nasal mucosa with one double-armed suture which was finally brought out anteriorly on the medial lip of the skin incision. The distal end of the tube was anchored to the opening of the nostril by a suture. The anterior leaves were then stitched in the same manner as the posterior ones.

To get a better cosmetic effect, the subcutaneous layer of the wound was carefully approximated by a continuous or interrupted sutures of 4-0 catgut. The skin wound was now closed by an interrupted suture of 2-0 silk or a continuous subcuticular stitch. A firm pressure dressing was applied after irrigating the eye with warm normal saline and instilling an antibiotic ointment into the conjunctival sac.

After 48 to 72 hours, the dressing was removed. The polyethylene tube was removed after four days by pulling it out through the external naris after cutting the anchoring stitches. The skin stitches were removed on fifth day, and gentle irrigation with warm sterile normal saline solution was carried out daily for 10 days. The insertion of the polyethylene tube proves very advantageous since it allows irrigation to be instituted early; it also prevents an accumulation of blood from organizing and occluding the opening.

Results

Among the total of 56 cases treated by this method, 39 have shown mucoceles, 11 have shown normal-sized sacs, and six have shown scarred fibrous sacs.

Operation was considered successful if, after good wound healing, the patient was symptomatically relieved and irrigation into the nose was easily performed. Of the 56 primary operations performed, 41 were successful by these criteria; eight were considered failures; in seven the result was doubtful. During the follow-up a detailed inquiry about epiphora was made. All patients were seen at the hospital at different intervals, ranging from a fortnight after operation to five months or even a year in some cases.

Hemorrhage was occasionally brisk. The angular vessels, which were severed on few occasions, were the principal trouble makers. However, this complication could be avoided by marking the vessels beforehand and placing the incision well away from them. Postoperatively, in a few cases, epistaxis occurred which was controlled by the administration of clauden, coagulen, and so forth and nasal packing for a few days. There was no incidence of infection.

Comments

Although good results have been obtained by all methods, I should like to stress that the external approach follows the sound surgical principles of good access, accurate exposure, and clean-layered suturing. A few months after operation, the incision scar is barely recognizable. It is probable that experience plays a part in achieving optimum results.

It is difficult to account for the failures which occur after this operation. Probably it is due to technical error at the time of operation, mainly of mechanical nature in making the opening (adequate size and posi-

tion) or in suturing the mucous membrane flaps. The lumen of the lacrimal sac may be a contributory factor, sometimes the operator may have sutured nasal mucosa to sac wall and not completely to sac lumen. Failure is evident within four to six weeks of the operation.

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JUXTATUMORAL CYSTS

AND OTHER RETINAL INVOLVEMENT IN MALIGNANT MELANOMA OF THE CHOROID

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Malignant melanoma may involve the retina in different ways. The tumor may grow through the retina, into the retina, or it may completely detach the retina.

At first the area of the retina covering the tumor becomes whitish, due to an edema of toxic origin, often resulting in an adhesion between the retina and the pigment epithelium and lamina vitrea. When the tumor perforates the lamina vitrea and grows into the subretinal space, it takes on a mushroom shape.

At this stage the retina may become totally detached; more often, however, only partly detached. As a rule the retina is adherent to the advancing head of the tumor and separated from the neck by albuminous fluid. The retina may be invaded or perforated at the top of the tumor and many changes, such as partial atrophy and cystic degeneration, may occur in this area of adhesion. The retina may be so thinned that only a pellicle of neuroglia separates the tumor from the vitreous.

In another type of invasion the tumor may penetrate the external layers of the retina and split it. The outer layers of the retina may be pushed into the recess of the neck of the tumor. Samuels and Fuchs mentioned in *Clinical Pathology of the Eye* (page 384) that "the splitting of the retina next to the tumor may become so extensive that a really large retinoschisis develops." Degeneration of the retina may become so marked here that large cysts are formed in the retina in the neighborhood of the tumor.

These juxtatumoral cysts seem to be rare. The first case was published by Ballaban in 1906. A malignant melanoma had developed on the temporal side of the papilla. The greater part of the tumor was extrascleral while the choroidal portion was flat. The retina was in apposition to a great extent especially over the macular area. On the nasal side of the tumor the internuclear layer of the retina showed a large cyst (fig. 1). Ballaban considered the cyst to be caused by osmotic conditions and explained the wrinkled sclera next to the swollen papilla and bent optic nerve as being due to the extraocular tumor. In this way some parts of the

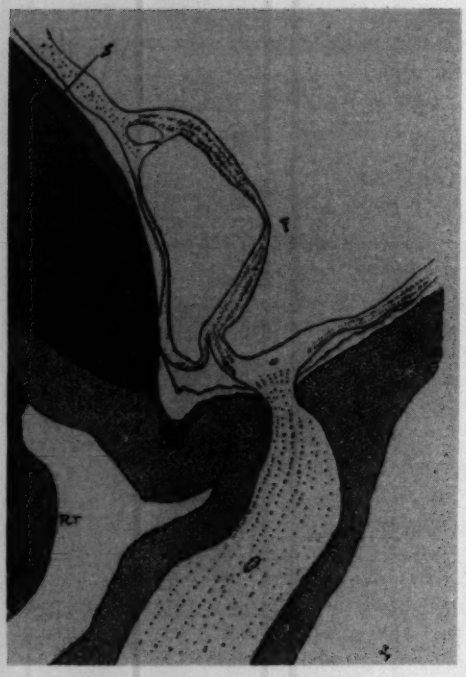

Fig. 1 (Samuels). Juxtatumoral cyst of retina. (S) Tumor. (RT) Retrobulbar tumor. (F) Juxtatumoral cyst. (O) optic nerve. (After Ballaban.)

retina were incarcerated between the choroidal tumor and the swollen papilla.

A similar case was reported by A. Fuchs in 1921. A large malignant melanoma occupied the nasal part of the ciliary body and choroid, extending backward to seven mm. from the papilla (fig. 2). The tumor was mushroom shaped. Between the head and base of the tumor was a niche in which the retina adhered to some extent to the head. Here a retinal cyst had developed. At the base of the melanoma the retina was detached by a fluid rich in albumin, while the fluid of the cyst itself was poor in albumin. As a rule, in cases of mushroom-shaped melanomas, the retina does not follow the tumor into the recess of the neck but bridges the region of the neck. (See Plate 42, fig. 4 of Samuel-Fuchs' book and Reese's *Tumors of the Eye*, fig. 114.) In Fuchs' case the retina was fixed at the neck of the tumor and so incarcerated in this cleft.

Case reports

Three cases of similar juxtatumoral cysts were found in the pathologic material at the New York Eye and Ear Infirmary.

Case 1 (8197)

A man, aged 72 years, had a history of poor vision in the right eye for one or two months. No inflammation was present. When the patient was seen in the clinic, a solid detachment was noted. Diagnosis was malignant melanoma of the choroid.

The globe is normal in size. The anterior chamber is normal, the filtration angle and Schlemm's canal are open. The iris and ciliary body are poorly pigmented.

There is a large mushroom-shaped tumor projecting from the choroid toward the vitreous cavity. The mass originates near the temporal equator and its bed extends posteriorly for about three disc diameters. The cells are mostly of the spindle type but the arrangement is bizarre and atypical. There is a tendency to pseudo-alveolar and tubular formation especially in the center of the growth. There are no areas of necrosis and the emissaria do not show involvement.

Temporally, beginning about two disc diameters from the papilla, the retina is detached by albuminous coagulum and tumor. The retina overlying the tumor has undergone extensive gliosis and thinning. In fact, in may places, it is invaded and eroded by tumor cells. In the recess between the retina, the choroid, and the tumor is a cyst caused by the adhesion of the outer layers to the tumor and a

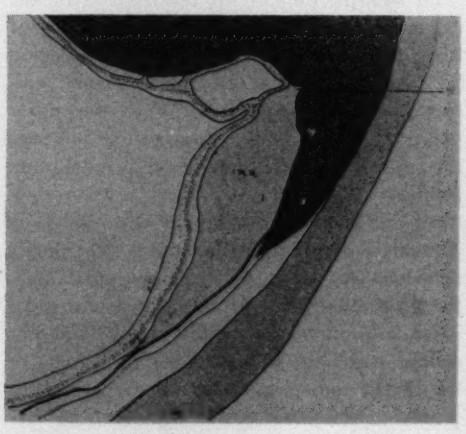

Fig. 2 (Samuels). Juxtatumoral cyst of retina. (N) Neck of tumor. (AR) Subretinal fluid. (After A. Fuchs.)

splitting of the retina into two leaves (fig. 3). This cyst was not visible clinically because it is situated behind the tumor. This posterior cyst contains much more albumin than a smaller anterior cyst running directly to the head of the melanoma but is quite differentiated from the subretinal fluid. The other parts of the retina and the optic nerve are normal.

CASE 2 (7617)

A woman, aged 61 years, whose history was not obtained.

The globe is of normal size, the filtration angle and Schlemm's canal are open. The iris and ciliary body are not heavily pigmented.

On the temporal side, from the ora serrata to near the macula, the choroid is replaced by a tumor mass shaped like a German loaf of bread. The tumor consists of round and spindle cells compactly disposed and arranged in interlacing bundles. The pigment is rather sparse, except in the posterior portion, due to necrobiosis. The tumor lies on a broad scleral bed but no extension into the emissaria or extraocular extensions were found.

The retina on the temporal side distal to the fovea is detached by serum and the tumor. Over the tumor the retina is invaded in one place by tumor cells and degenerated elsewhere. Some sections show the retina split in the external plexiform layer, the external nuclear layer adherent to the tumor and albuminous fluid filling the space of separation, which appears like a cyst (7.0 by 5.0 mm.). The anterior wall of the cyst shows clearly the inner nuclear layer, while the outer wall is much thinner and consists of neuroglia. Here the cyst is not squeezed into a recess, but is considerably elevated and projects more against the vitreous than the melanoma. Therefore the cyst must have been visible clinically.

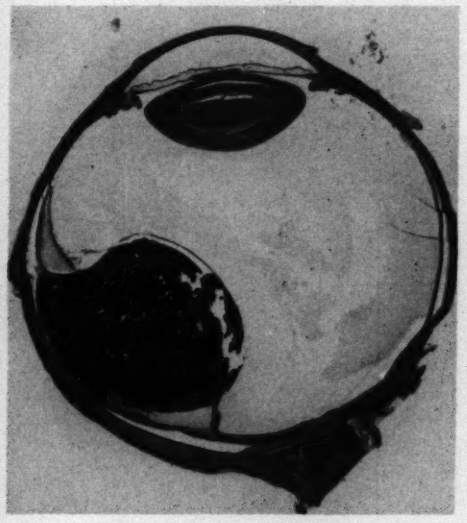

Fig. 3 (Samuels). Findings in Case 1.

Fig. 4 (Samuels). Findings in Case 2.

CASE 3 (7045)

A woman, aged 45 years, about three weeks ago, first noticed poor vision in the right eye, which has grown worse. There was no pain or redness or history of trauma. The diagnosis was malignant melanoma of the choroid.

The globe is of normal size. The cornea is clear. The sclera shows a deep scleral bed of the tumor and extension into an emissarium. The anterior chamber, filtration angle, and iris are normal. The flat part of the ciliary body is detached by the choroidal tumor.

At the equator a large heavily pigmented mushroom-shaped melanoma has taken the place of the choroid on one side. The tumor is composed of interlacing bundles of oval and spindle-shaped cells, compactly arranged. The tumor infiltrates the ciliary body anteriorly. Where the retina is in contact with the head of the tumor, it is almost destroyed and replaced by glial tissue. Posteriorly there is a minimum circumpapillary detachment of the retina, and the fovea is detached. On the posterior side of the head of the tumor the retina is divided into two layers forming a cyst containing clear, lightly stained fluid which stands out by contrast to the deeply stained albuminous fluid of the subretinal space.

The cyst is extended somewhat but is not protruding as in Case 2. Since the cyst was lying behind the tumor, it undoubtedly could not be seen

Fig. 5 (Samuels). Findings in Case 3.

with the ophthalmoscope. The contents of the cyst show much less albuminous coagulum than the subretinal fluid, which is in contrast to Cases 1 and 2.

Comment

In all of these cases the cysts were situated on the posterior side of the malignant melanoma. This may be explained by the fact that the retina is thinner in front of the tumor and has much less vascular supply compared with the area behind the tumor. Therefore more congestion is likely in the posterior part of the retina; the greater thickness makes the formation of a cyst much easier.

In the cases of Ballaban and A. Fuchs, a certain incarceration was the cause of the formation. However, in all of the cases reported herein, production of fluid took place. The fact that some of these cysts are extended and their color differs from the subretinal fluid shows that there is active production of fluid, probably due to a toxic stimulus from the tumor. This seems quite likely since the wall of the cyst lying on the tumor is often so thin that toxic substances could easily enter the cyst.

In Ballaban's case and Case 2 reported herein, the surface of the cyst was elevated over the top of the tumor and might have been visible clinically. In any event, since these cysts are rare and have not been described in the literature in recent years, reporting them may lead to their clinical appreciation.

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A SUTURE-LOOP RETRACTOR

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Surgeons using a preplaced suture with a loop retracted through a groove in the corneoscleral tissue have experienced the misfortune of accidentally cutting the suture during the keratome section or scissors enlargement of the wound. Even expert assistants have difficulty in retracting the loop satisfactorily with forceps during the time of the keratome section. The difficulty of managing the suture is increased when using gut material which is less manageable than silk.

The instrument (fig. 1) described here was designed in an effort to control the loop of a preplaced suture and at the same time facilitate the controlled opening of a scleral groove for the introduction of the tip of a keratome without obscuring the surgeon's view of the operative field or interfering with the sectioning procedure.

It consists of a plastic strip approximately

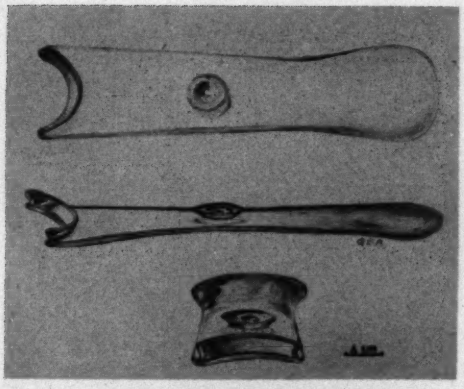

Fig. 1 (Arrington). (Upper) Top view of transparent plastic suture loop retractor. Note handle modified as lid plate and the central peg. (Middle) Side view of loop retractor. (Bottom) Front-end view of loop retractor.

2.5 cm. by 10 cm. by 2.0 mm. thick. The loop retractor end of the instrument is shaped into a hollow U form with a raised and backwardly inclined edge suitable for holding the suture loop. The ends of the U-shaped edge are notched to retain both the loop and the two ends of the suture which are crossed over the central portion of the loop retractor above a peg and are controlled by sliding pressure of the assistant's thumb. The handle end of the loop retractor is shaped into a lid plate, thus giving the instrument a second purpose. Another incidental use is as a lid retractor. Retraction is accomplished by catching the lid margin over the raised U-shaped edge, obtaining excellent exposure of the eye.

Technique

Following the reflection of the conjunctival flap, a groove is produced, as by means of an Alvis-Lancaster keratome, and the suture is passed backward through the depth of the groove. The loop is picked up from the floor of the groove with the single-toothed side of a Bracken fixation forceps and lifted from the groove. Without releasing the suture, in order to maintain proper orientation, the loop is immediately

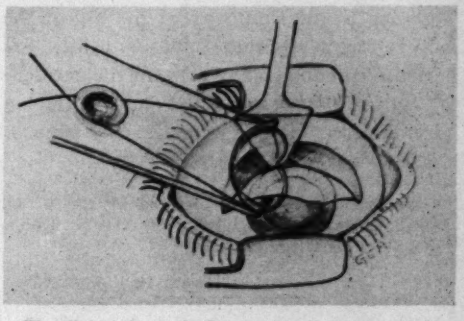

Fig. 2 (Arrington). Loop retractor in place during keratome section with suture ends crossing above peg. Keratome illustrated as transparent to permit viewing suture arrangement. Loop protected behind U-shaped edge of retractor.

placed over the loop retractor and the two ends of the suture are crossed over the central peg of the loop retractor (fig. 2). The assistant controls the opening of the lips of the groove by sliding the ends of the suture backward or forward as the need arises. The U-shaped end of the loop retractor is held close to the globe, as shown in Figure 3, to avoid any interference with the introduction of the keratome. The enlargement of the section is then carried out with the corneoscleral scissors in both directions away from the groove. The loop is then released by the simple maneuver of elevating the handle 90 degrees, allowing the loop to fall from the loop retractor.

Transparency of the instrument allows adequate visualization of the operative field while the instrument is in place. The instrument is equally useful on either the right or the left eye.

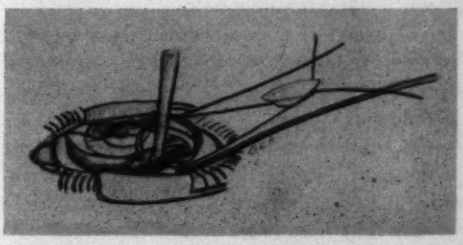

Fig. 3 (Arrington). Loop retractor in place during keratome incision as viewed from above. Note position of end of retractor near globe.

Owing to the simplicity of the use of the loop retractor, even assistants with little experience can adequately prevent the accidental cutting of the preplaced sutures during keratome section and scissors enlargement.

810 West Franklin Street.

The instrument is manufactured by the R. O. Gulden Company, 225 Cadwalader Avenue, Elkins Park 17, Pennsylvania.

NEURILEMMOMA OF THE ORBIT*

B. C. Sharma, D.O. (oxon.)
AND
O. P. Kulshrestha, M.S.
Jaipur, India

Neurilemmoma is a localized benign nerve-sheath tumor occurring anywhere along the course of a spinal, cranial, or sympathetic nerve. Among the cranial nerves, the acoustic nerve is the commonest single site and most of these tumors arise in or near the internal meatus. In routine sections of the temporal bone, Hardy and Crowe discovered several examples of tiny symptomless tumors of the auditory nerve deep in the canal. Neurilemmomas occur more rarely in association with other cranial nerves but have been noted arising from the ciliary nerves (Callender and Thigpen 1930, Papoleczy 1932).

In most cases, such typical growths are solitary and unaccompanied by any signs of neurofibromatosis or other lesions of the nervous system. However, in a minority of cases, the tumors may be multiple or may be accompanied by neurofibromatosis or by such minor stigmas of the disease as pigmented spots over the body or a few cutaneous nodules.

Only a few cases of neurilemomas of the orbit have been reported in the literature. The tumor is reported to grow extremely slowly and sometimes rather intermittently.

*From the Department of Ophthalmology, S. M. S. Medical College.

Fig. 1 (Sharma and Kulshrestha). Photomicrograph of tumor tissue, showing fascicular arrangement of the cells.

Pescatori's patient (cited by Reese) was aged two years when the tumor was noted. It remained unchanged for 15 years and then resumed growth.

The tumor causes the usual exophthalmos and, when large enough, blurring of vision due to pressure on the optic nerve. There may occur some impairment to the motility of the eye. Such tumors seldom recur after local excision.

Two distinct but, of course, not completely separable microscopic types are encountered:

1. *Fasciculated or so-called type-A tissue* is more characteristic. There is an orderly arrangement of parallel cells and intercellular fibers, forming interwoven bundles. The tendency of the nuclei to arrange themselves in rows with clear intervening spaces is a characteristic referred to as palisading.

2. *Reticular or so-called type B tissue* shows a disorderly loose meshwork of cells of variable shape, often with plentiful intercellular vacuoles or microcysts.

Case report

Patient Mangala, aged 15 years, a Hindu boy, was admitted in September, 1954, complaining of

gradually increasing proptosis of left eye for about two years. For the first year there was some fullness of the eye but during the last 12 months there had been increasing protrusion of this eyeball. On examination no tumor mass could be felt anywhere in the left orbit. The eye had proptosis of four mm.

Corrected vision was: R.E., 20/20; L.E., 20/20 partial. Fundus examination of the left eye showed edema of the optic disc (papilledema) of about two to three diopters with blurred disc margins. The optic disc was markedly hyperemic and the veins were congested and tortuous. Fundus examination of right eye was normal.

All the examinations, including skiagrams of both orbits and optic canals, and blood studies were negative.

The patient, fearing that some sort of operation on his eye was being contemplated, left against medical advice. He was readmitted in April, 1958 (about three and one-half years after the first admission), with a much greater degree of proptosis of the left eye and markedly diminished vision. He also complained of pain in the left eye and occasional frontal neuralgic pains.

On examination (April, 1958) there was marked proptosis of the left eye, with widening of the palpebral fissure. The movements of the eye were in full rang in all directions except nasally where they were slightly restricted. At no time had he noticed any diplopia.

A softish rubbery mass, palpable between the eyeball and the inferior orbital surface, also extended toward the medial side. Palpation of the orbital margins did not show any abnormality.

With the patient looking straight ahead, about three to four mm. of the sclera at the lower limbus remained uncovered by the lower lid, blinking was free and the eye could be closed completely. Exophthalmometry (Hertel) revealed 17 mm. of proptosis of the left eye. Conjunctiva, cornea, and iris were normal. Pupillary size and reaction to light were normal.

Fig. 2 (Sharma and Kulshrestha). High-power view of Figure 1.

Vision was: R.E., 20/20; L.E., finger counting at two feet (no improvement with glasses).

Fundus examination of the left eye showed slight edema of the optic disc, with blurred disc margins. The disc was definitely pale and showed secondary optic atrophy. Veins were still convoluted. The fundus of the right eye was normal.

Systemic examination, including neurologic examination, revealed nothing abnormal. Blood pressure was 124/82 mm. Hg. A lateral skiagram of the skull was normal. The left orbit was markedly enlarged as compared to the right. Both optic canals were normal. The inferior orbital fissure was obviously wider in the left eye as compared to the right.

Total and differential white cell counts were normal. No immature or abnormal white cells could be seen. Blood for Kahn's test was negative. On transillumination, both the frontal and maxillary sinuses were normal. A small piece of tumor tissue was taken for biopsy by incising the overlying conjunctiva in the lower fornix. Histopathologic examination showed neurilemmoma, with both type-A and type-B cellular structure (figs. 1 and 2).

Operation. Under local anaesthesia the orbit was opened from the lateral orbital wall (Krönlein's operation). It was thought that this would give the best possible approach for removal of the growth. An external canthotomy was done and the skin incision extended posteriorly. The skin was dissected above and below to the periosteum and to the muscle fascia. The external canthal ligament and septum orbitale were incised. After incising the periosteum, the lateral orbital wall was resected with a small saw aided by a hammer and chisel. The orbit was explored from the lateral side; no tumor could be felt.

Since a mass could be felt extending medially on the floor of the orbit, the tumor was located through a semilunar conjunctival incision about 10 mm. from the limbus and extending medially. The medial rectus and inferior oblique muscles were cut. The tumor mass was located and shelled out with the index finger. The tumor, extending rather deep into the orbit, was soft in consistency and resembled a lipoma.

The cut rectus muscles and the conjunctiva were sutured. A rubber drain was inserted in the lateral wound in the orbit. The day after the operation, there was no bleeding but some seepage. There was some conjunctival edema in the lower fornix and no perception of light in the operated eye.

Four weeks after the operation, cosmetically both the eyes looked well with no obvious proptosis of the left eye. However, the left eye had no perception of light, the optic disc was pale and atrophic. Obviously the optic nerve and its blood supply were damaged while shelling out the tumor.

Summary and Conclusions

A rare case of neurilemmoma of the orbit is presented. It may be conjectured that this growth was close to the second division of the Vth nerve (superior maxillary nerve) as it passes into the inferior orbital fissure (spheno-maxillary fissure) near the floor of the orbit.

The proptosis due to the growth increased 13 mm. (from 4.0 mm. to 17 mm.) in about three and one-half years. It should also be noted that it caused papilledema rather early.

Acknowledgment

We are greatly indebted to Dr. B. N. Consul, ophthalmologist and Dr. B. N. Sharma, senior surgeon, S.M.S. Hospital, Jaipur for their valuable help. We are also grateful to Dr. D. P. Gupta, pathologist, for examining the slides and preparing the microphotographs.

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MODIFIED HANDLE FOR ELECTRO-KERATOTOME*

A. Benedict Rizzuti, M.D.
Brooklyn, New York

The electro-keratotome of Castroviejo currently in use for lamellar keratoplasty consists of two main sections; the cutting head and the electric motor handle. It has been employed successfully in obtaining from a donor eye a cleanly cut, circular lamellar corneal graft of even thickness. The occasional surgeon may have had the experience of finding the present type of motor handle rather awkward and somewhat cumbersome to use because of its odd shape.

To overcome this difficulty the motor handle was changed. A Norelco cylindrical type handle† was modified and adjusted to fit

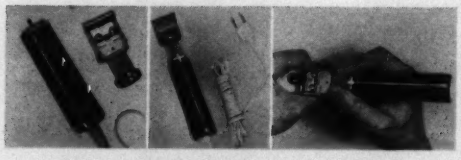

Fig. 1 (Rizzuti). Electro-keratotome with modified handle.

securely to the plastic circular base of the cutting head. The cylinder measures four inches in height and slightly over one inch in diameter. It operates on either A.C. or D.C. current of 110 to 220 volts. The distinct advantage of this type handle are: (1) lightness in weight, (2) easier to manipulate, and (3) can be properly draped with a sterile sleeve when ready for use.

With this new type cylindrical motor handle two lamellar grafts of different sizes and thicknesses have been removed with greater facility.

160 Henry Street (1).

* Used at the Brooklyn Eye and Ear Hospital Corneal Clinic.

† This instrument may be obtained from the Storz Instrument Company, 4570 Audubon Avenue, Saint Louis 10, Missouri.

DEVELOPMENTAL ABNORMALITY OF POSTERIOR ASPECT OF THE CORNEA*

VICTOR GOODSIDE, M.D.
Bronx, New York

An unusual developmental abnormality of the posterior aspect of the cornea is being reported because no reference to a similar case could be found in the literature.

CASE REPORT

A 59-year-old man in good health came for routine eye examination with no ocular complaints except for occasional burning of the eyes. He was found to have a small chalazion on each upper lid. Both corneas showed the lesion which is the subject of this report. The eyes were otherwise entirely normal. Visual acuity was 20/20 in each eye with correction in the right eye of +1.0D. sph., and in the left eye of +0.75D. sph. Intraocular pressure was 20.3 mm. Hg in each eye.

The corneal lesion (fig. 1) was similar in each eye. It consisted of an annular ribbonlike opacity 2.5 mm. from the limbus and concentric with it. The opacity was just visible by oblique illumination. It was at the level of Descemet's membrane or the corneal endothelium, did not project at all into the anterior chamber or extend anteriorly into the stroma. It was entirely flat and gray and was unaltered in any respect throughout its course. Its width measured several 10ths of a mm. Midway between the ribbonlike opacity and the center of the cornea was a second but thinner opacity, similarly situated at the level of Descemet's membrane or the endothelium. This opacity was perhaps one fifth the diameter of the more peripheral one. It was similarly gray when seen by slitlamp but could not be visualized under ordinary oblique illumination. It was oval in shape, the vertical diameter being slightly wider than the horizontal one, and the oval reached somewhat closer to the thicker opacity at the 12-o'clock position than at the 6-o'clock.

The cornea was entirely clear except for these opacities. No evidence of embryotoxon was observed. Gonioscopic examination showed a deep and open angle. Trabecular elements were well visualized and no anomalous structure was seen. The iris showed normal markings without hypoplasia. The media were otherwise clear. The fundi were normal.

DISCUSSION

Related conditions are noted in the literature under the titles of posterior embryotoxon and hyaline membrane of the posterior surface of the cornea.

Fig. 1 (Goodside). The actual appearance of the lesions differs from this illustration in that (1) the opacities are less visible to oblique illumination and (2) the outer opacity is about five times as broad as the inner one.

Posterior embryotoxon is stated by Duke-Elder[1] to be an annular opacity of the cornea continuous with the sclera and differentiated clinically from arcus senilis by the presence in the latter of peripheral clear cornea.

Axenfeld[2] used the term embryotoxon to describe a case in which an opaque ring existed at the posterior surface of the cornea some distance from the limbus. Fine fibrils passed from the iris to the opaque ring and he noted a delicate blur of the cornea peripheral to the opaque ring.

Braendstrup[3] reported posterior embryotoxon occurring in three generations of a family. Of 12 persons examined he found seven who had a congenital lesion consisting of a coalescence between the posterior surface of the cornea and the peripheral part of the iris stroma. An incomplete pseudochamber angle was thereby formed, dividing the anterior chamber into a major central portion and a small peripheral portion consisting of the true angle. The posterior corneal opacity was peripheral and of varying widths. Affected members of the family had other anomalies. Two had very small eyeballs with corneal diameters of nine to 10 mm. In four there were anomalies of the optic papilla. One had absolute glaucoma following unsuccessful medical and surgical therapy.

* From the Lebanon Hospital, New York.

Three cases of hyaline membranes of the posterior aspect of the cornea were recorded by Mann.[4] The membranes were sheetlike, semitransparent structures occupying the periphery of the cornea and associated with a number of hyalinelike strands stretching across the anterior chamber. Some of the strands were attached to the iris. The iris stroma seemed abnormal in two of the cases. Mann alluded to a similar case reported by Ballantyne[5] which occurred in a six-day-old child having, however, the additional features of clear-cut inflammatory findings such as keratic precipitates and aqueous flare. Mann stated that her own cases were undoubtedly the result of aberration of development rather than of inflammatory origin, as seemed the case in Ballantyne's report.

Embryologically[6] at the 18-mm. stage (six weeks) of development a chink appears in the mesoderm located between the surface epithelium and the anterior surface of the lens. This interval then divides the mesoderm into an anterior corneal portion and a posterior pupillary membrane portion. With further development the interval widens to form a more definite anterior chamber. At 25 mm. (seven weeks) the pupillary membrane is divisible into a thicker peripheral portion and a thinner central portion. The ectodermal iris grows forward anterior to the lens and the mesoderm in contact with it becomes thicker and more vascular. At approximately the seventh month the pupillary membrane begins to atrophy, the process involving the central part only. By eight and one-half months the process is almost complete and the lesser iris circle has begun to assume its adult appearance.

Embryotoxon and hyaline membrane of the cornea are undoubtedly the result of aberration in the development of the anterior chamber. Incomplete differentiation between the anterior surface of the iris and posterior surface of the cornea occurs and as a result adhesions between cornea and iris exist, and iris anomalies such as hypoplasia are noted.

Explanation of the anomaly in the case being reported must take into account the following circumstances: bilaterality, absence of inflammation, a double annular opacity in no way resembling in location the corneal opacities of embryotoxon or hyaline membrane, absence of iris hypoplasia or other anomaly, absence of adhesions between iris and cornea, and absence of angle abnormalities.

The double annular opacity is particularly suggestive of a relationship to the pupillary membrane. Such a possibility would require that the pupillary membrane develop and atrophy prior to the formation of the anterior chamber. As already indicated the anterior chamber is first seen as a slit at an early stage (18 mm.) and rapidly widens thereafter, while the pupillary membrane does not begin to atrophy until the seventh month. However, Mann[6] does state that "in many specimens, even up to the sixth month the anterior chamber appears empty, extremely narrow and compressed. Its early anatomic differentiation is not correlated with an early function."

If, therefore, it could be assumed that the pupillary membrane atrophied while still in approximation to the cornea, a tenuous contact between the pupil and the lesser iris circle, on the one hand, and the posterior aspect of the cornea, on the other, might be held responsible for the production of the double annular cornea opacity.

1777 Grand Concourse (53).

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INSTRUMENT FOR GONIOTOMY PROCEDURES*

And description of a technique for keeping the anterior chamber filled and aiding hemostasis

Francis B. Wells, M.D.
Detroit, Michigan

One of the problems in goniotomy procedures is the maintenance of a full chamber to facilitate access to the angle and to aid in protecting the lens as the instrument is passed over it and manipulated. Another problem arises if bleeding obscures the angle before completion of the goniotomy. I have used the procedure herein described in four goniotomy operations with satisfaction.

The instrument (fig. 1) is a rounded tip, partially blunted, highly polished 23-gauge hypodermic needle 1.5-inches long connected at its hub to a plastic intravenous tube, the other end of which is attached to a saline-filled 50 cc. syringe with the plunger removed. A standard intravenous bottle was used in one instance but the syringe seemed easier to manipulate. The needle has been used both with and without a handle; it is preferred without.

A small incision is made in clear cornea with a Ziegler knife, just large enough to give a free but not too loose tract for the goniotomy needle. Following this the chamber will partially collapse but will immediately reform on insertion of the needle and elevation of the syringe. To give complete filling of the chamber, the syringe is usually raised two to three feet above the needle hub. Chamber depth is easily changed by raising or lowering the syringe. Approach to the angle is easy and it remains clearly visualized, except for the slight corneal haze due to the congenital glaucoma.

In the two cases in which it occurred, hemorrhage was well controlled. In the first case bleeding began when the syringe was lowered. On elevation of the saline level, it stopped. This was repeated three times; finally, the pressure head was elevated and held for seven minutes, with no subsequent bleeding on reduction of pressure. In the second case, the pressure was elevated at the first sign of hemorrhage, and held during the remainder of the procedure and for a few minutes thereafter. No further hemorrhage occurred.

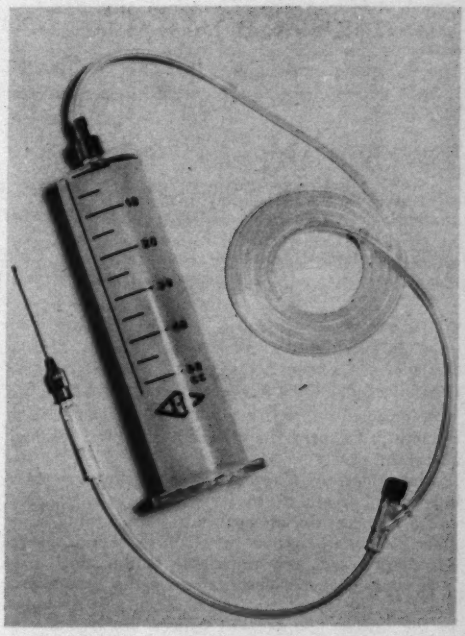

Fig. 1 (Wells). The instrument for goniotomy procedures.

In one case the Ziegler knife incision was made larger than intended and saline escaped continuously around the needle; however, full chamber depth was maintained by elevating the water level slightly higher.

Air could be injected at the end of the procedure through the same needle. But this was troublesome unless a T valve was inserted. However, it is a simple matter, after withdrawing the needle, to press the foot plate of a Bell erisophake snugly against the cornea, over the incision, and inject air.

Henry Ford Hospital (2).

* From the Department of Ophthalmology, Henry Ford Hospital.

OPHTHALMIC RESEARCH

EDITED BY FRANK W. NEWELL, M.D.
950 East 59th Street, *Chicago 37, Illinois*

SOME SOURCES OF FUNDS FOR RESEARCH AND TRAINING IN THE FIELD OF OPHTHALMOLOGY AND BLINDNESS

The National Committee for Research in Ophthalmology and Blindness, 406-C South Boulevard, Evanston, Illinois, Frank W. Newell, M.D., *Secretary.*

AMERICAN CANCER SOCIETY, INC., *521 West 57th Street, New York 19, New York.*

A principal objective of the American Cancer Society is to speed the conquest of cancer through research.

The American Cancer Society makes grants in support of research to increase knowledge about cancer. Therefore, an applicant for a grant should state clearly the extent to which he thinks the research proposed may contribute to this end.

A comprehensive description of the grants provided by the American Cancer Society is contained in the article "Support of cancer research by the American Cancer Society" published in the *Journal of Medical Education,* **31**:4-31 (Sept. Pt. 2) 1956.

AMERICAN FOUNDATION FOR THE BLIND, INC., *15 West 16th Street, New York 11, New York.*

The American Foundation for the Blind's interest in research on blindness is in research and development programs in technologic and social research. The Foundation's main effort is in acting as a clearing house for existing research and for stimulating and promoting new research.

The American Foundation for the Blind does not grant research fellowships or make grants-in-aid for research purposes as a rule, although currently it is sponsoring a project at the University of Illinois under Dr. Ernest Newland on the development of a test to predict children's ability to learn braille. The Foundation has also contributed to a longitudinal study of persons with retrolental fibroplasia at Northwestern University Medical School, and is currently undertaking a study of the unmet reading needs of blind persons.

The American Foundation for the Blind maintains close contact with and occasionally provides consultative services for the following projects: The sensory aids project at Massachusetts Institute of Technology; projects in audition at C. W. Shilling Laboratory in New London, Connecticut, and at the Cleveland (Ohio) Society for the Blind; on programming an IBM 650 computer for braille at Wayne State University; on the rehabilitation of severely emotionally disturbed blind children at the New York Institute of Physical Medicine and Rehabilitation; on attitudes toward blind people at the New York School of Social Work at Columbia University, and others.

The Foundation has also provided consultative services to the U.S. Office of Vocational Rehabilitation, the National Health Survey, the Veterans Administration, and various congressional study committees, notably the Elliott Subcommittee on Special Education and Rehabilitation. Several research projects in the initial planning stage are also being provided consultative services.

AMERICAN MEDICAL ASSOCIATION, *Secretary of the Committee on Research, 535 North Dearborn Street, Chicago 10, Illinois.*

Each year through the Subcommittee on Grants-in-Aid of the Committee on Research, the American Medical Association makes available funds to foster investigations of therapeutic interest. Grants are limited to the sum of $500 or less and may be used for any purpose in this broad general field except for payment of salaries or services.

As a rule, no more than two grants are given to any one institution and no more than $700.00 will be recommended to any one university.

ATOMIC ENERGY COMMISSION, *Division of Biology and Medicine, Washington 25, D.C.*

Through its Divisions of Research, Biology and Medicine, and Reactor Development the Atomic Energy Commission contracts with independent institutions for research in fields related to atomic energy. Under these contracts the universities, colleges, industrial laboratories, and other research institutions contribute to scientific progress in fields related to the development and use of atomic energy. Applied research directed towards specific goals of practical accomplishment and basic research which discovers new principles and broadens our understanding of physical and biologic phenomena are both essential.

In selecting projects for support under these programs, the Atomic Energy Commission recognizes the importance of independent research, and its policy is to assist competent investigators working in an environment favorable to productive research along lines which the scientist himself considers promising and consistent with the interest of his

institution. Usually his institution continues to make its normal contributions to his research expenses. At the same time it must be emphasized that the AEC only participates in programs of research which are related to its statutory responsibilities.

A type of arrangement which the Commission has adopted for assisting research in independent institutions is the lump-sum cost-sharing contract. These contracts can be used when the annual cost to the AEC is less than $100,000.00 and can be estimated with reasonable accuracy in advance. In consideration for the institution's carrying out the agreed investigations and submitting a satisfactory report, the AEC agrees to pay a lump sum based upon an agreed part of the estimated total cost. The prospective contracting institution bases its proposal upon a clearly delineated level of activity which is used as a basis for estimating the cost. In making its proposal, the institution states what part of the total costs it is prepared to bear and what part it requests from the AEC.

BIO-SCIENCES INFORMATION EXCHANGE, *1825 Connecticut Avenue, N.W., Washington 9, D.C.*

The Bio-Sciences Information Exchange maintains a listing by topic and supporting organization of research projects supported by government and lay organizations which cooperate in the Exchange. Information concerning current studies in nearly every field of biologic research may be obtained, providing the research is supported by a national agency.

COMMONWEALTH FUND, *1 East 75 Street, New York 21, New York.*

The Commonwealth Fund each year awards a limited number of advanced fellowships in medicine and closely allied fields. The primary objective is to advance medical teaching and research by providing opportunities for the additional training of selected members of the medical school faculties. It is preferred that applicants be members of a university teaching staff or be assured of such an appointment on the completion of a period of fellowship work. Applications should be supported by the dean of the school or head of the department or organization concerned. Priority is given to individuals who have had several years of graduate experience in teaching or research and who will occupy a strategic position in relation to the institution's program.

Tenure is usually one year and the stipend is adjusted to the individual situation. Applications are received at any time and awards are made several times each year. No application forms are used. The applicant is asked to submit a full statement of his interests, proposed program of study and plans for the future, accompanied by curriculum vitae, endorsement of the application by the sponsoring organization, and an estimate of financial needs during the fellowship period.

DELTA GAMMA FRATERNITY, *1820 Northwest Boulevard, Columbus 12, Ohio.*

This group has a major interest in sight conservation and aid to the blind. Each fraternity chapter may choose its own field of volunteer work, dependent upon the needs of the community. The conditions of and qualifications for financial support are flexible. A professional committee passes on each application, and these must be submitted by May 1st each year.

DEPARTMENT OF THE AIR FORCE, *Washington 25, D.C.*

The Department of the Air Force is interested in supporting biologic research relating to maintaining efficiency of personnel in Air Force operating environments. In the area of ophthalmology, harmful effects of electromagnetic and ionizing radiations are of particular concern.

Unsolicited research proposals are welcomed and should be addressed to one of the following agencies:

Commander, Air Research and Development Command
Andrews Air Force Base
Washington 25, D.C.

Commandant, Aerospace Medical Center
Brooks Air Force Base
San Antonio, Texas

DEPARTMENT OF THE ARMY, *Washington 25, D.C.*

The funds with which the Department of the Army's Medical Research and Development Command operates are primarily appropriated to support medical research of high military priority. The general improvement in the care and treatment of sick and wounded soldiers and finding methods for preventing disease and injury among the troops are considered to be within this mission. Both basic and applied research are supported.

As to ophthalmologic research, the following are of particular interest: night vision and ways it may be improved, flash blindness, retinal burns and other conditions which might be caused by detonation of nuclear weapons (or the effects of light, heat and ionizing radiation similar to that emitted by nuclear weapons); practical eye armor to protect the eyes of soldiers against the effects of small low velocity primary and secondary missiles and possibly against the flash and heat of nuclear weapons. Problems such as strabismus and diabetic retinopathy are not the type that would receive research support.

DEPARTMENT OF THE NAVY, *Office of Naval Research, Washington 25, D.C.*

The Office of Naval Research was created to bring scientific research to bear on naval programs. Part of the program of the Office of Naval Research is conducted in its own laboratory, and part is in sponsored programs conducted in universities, nonprofit institutions and industrial laboratories. The Office of Naval Research sponsors a broad program in basic research in selected scientific fields having important bearing on Navy problems. Support in these fields is given to proposals having the greatest scientific merit, with careful consideration

given to competence of the investigator and the facilities available for research.

The Biological Sciences Division consists of five branches:

1. Physiology, including nerve and muscle function, aviation physiology, diving and submarine physiology; biophysics, physiologic implications of climatic and operational hazards; energy metabolism, and comparative and cell physiology.
2. Biochemistry.
3. Microbiology.
4. Medicine and dentistry including application of fundamental sciences to selected problems of naval medicine and dentistry dealing with the prevention and treatment of injuries with emphasis on preservation and transplantation of tissues.
5. Biology.

The Psychological Sciences Division consists of four branches: (1) Group psychology, (2) physiological psychology including audition, vision and other special senses, response mechanisms, perception and spatial orientation, neurophysiological correlates of behavior, and psychophysiological factors in human tasks under normal and stressful conditions; (3) engineering psychology, and (4) personnel and training.

Other major groups are Earth Sciences Division, Material Sciences Division, Physical Sciences Division, Mathematical Sciences Division, Naval Applications Group and Naval Analysis Group.

The Office of Naval Research has branch offices in Boston, New York, Chicago, San Francisco, Pasadena, and London, England.

Fraternal and Service Groups

The Elks Club and the Lions Club have in past years supported eye research in various localities. The direction of these groups is largely local and autonomous, and funds are not available from the Central National Headquarters.

Fulbright Fellowships, *Institute of International Education, 1 East 67th Street, New York 21, New York.*

The Fulbright Act authorized the Secretary of State to set aside a portion of the foreign currencies resulting from the sale of surplus government property abroad for educational exchange programs with certain foreign countries in all fields of teaching and advanced research in institutions of higher learning abroad.

Stipends bear a reasonable relation to the grantee's salary. An additional allowance may be provided for housing, cost of living, books and equipment, local travel, and so forth. Arrangements for transportation are made in certain instances.

Guild of Prescription Opticians of America, Inc., *110 East 23rd Street, New York 10, New York.*

Six fellowships for residents in ophthalmology are awarded each year by the Guild of Prescription Opticians of America. The purpose of the Guild program is to encourage and enable outstanding young physicians to become residents in ophthalmology at accredited medical institutions.

Each fellowship is worth $1,800.000, payable in monthly stipends over the three-year period of residency.

In addition to aptitude, scholastic ability and integrity, the applicant must be accepted as an ophthalmic resident in an American Medical Association approved three-year program. Letters of recommendation from the dean of the medical school from which the applicant graduated and the medical director of the hospital at which he interned must be submitted.

One grant is available to each of six geographical areas embracing the United States and Canada. The grant to each area is determined by the location of the institution in that area at which the residency is to be served and not by the applicant's home. The Guild sponsors the entire cost of the fellowship program. Selection is made in each area by a committee of ophthalmologists.

Application forms and further information may be obtained by writing to Guild Fellowships, the Guild of Prescription Opticians of America, Inc., 110 East 23rd Street, New York 10, New York.

Heed Ophthalmic Foundation, *100 North Euclid Avenue, Saint Louis 8, Missouri.*

The purpose of this organization is to promote, aid and further the education of persons showing exceptional promise in ophthalmology.

Applicants must be citizens of the United States. They must have completed three years of training, at least two of which have been directed toward the study of ophthalmology or the equivalent of such a course under the preceptorship of a well recognized ophthalmologist. It is desirable that they have a definite appointment for a teaching position upon the completion of the fellowship.

It is essential that the applicant be recommended as a man of outstanding ability by the head of the department of ophthalmology under whom he has worked, or by a competent ophthalmologist who is well acquainted with the applicant's ability.

At the present time the amount of the grant is $3,600.00 for a six months' fellowship. There is no deadline date for application.

Institute of International Education, *1 East 67th Street, New York 21, New York.*

These fellowships are open to United States citizens for study abroad under the terms of the Fulbright Act. Generally awards are given to candidates under 35 years of age and not primarily for medical study but to cover board, lodging, tuition and travel for young doctors or graduate students for study or research in some branch of medical science. Competition for the succeeding academic year closes October 15th.

Foreign doctors may apply for various American opportunities through the Institute's Committee on Study and Training in the United States. Offices are

located in most capitols throughout the world. The American embassy in each country may be contacted for details.

KNIGHTS TEMPLAR EYE FOUNDATION, INC., *30 East Market Street, Rhinebeck, New York.*

The Knights Templar Eye Foundation, Inc., makes direct grants to university departments of ophthalmology for the support of ophthalmic research. These grants are unsolicited and are made on the recommendation of an Ophthalmic Advisory Board after discussions with the Board of Directors. The amount of money available for research grants varies each year and is dependent upon appropriations made from the same fund to the support of eye surgery in individuals approved by the Foundation.

NATIONAL COUNCIL TO COMBAT BLINDNESS, INC., *41 West 57th Street, New York 19, New York.*

This organization awards Fight for Sight grants-in-aid, research fellowships and summer student fellowships. No set amount is established for the grants-in-aid. In 1959-1960 it varied from $750.00 to $6,900.00 per annum and was based on an analysis by the Scientific Advisory Committee of the project and the budget submitted by the applicant and on available funds. Research and fellowship stipends are determined on individual circumstances and may vary from $3,600.00 to $7,500.00. The summer student fellowships may vary from $200.00 to $300.00 per month.

Support is given to work in the field of ophthalmology, including clinical investigative medicine, the biological, chemical and physical sciences, as related to sight. The conditions of the awards are as follows:

1. *Grants-in-aid.* These are awarded to universities, institutions and laboratories. Generally they are awarded for one year, for a specific project, under the supervision of a principal investigator with institutional approval. Applicants are generally notified by July and the awards usually commence August 1st. Application may be made for renewal support of a grant-in-aid.

2. *Research fellowships.* These are awarded on a full-time basis to qualified investigators, usually for one year. The fellow is to obtain his own institutional appointment and project supervisor. Appointment usually begins August 1st and notification of the award is made in July. Under special circumstances, the applicant is notified earlier and the appointment date may be between May 1st and July 1st. The fellowship may be renewed.

3. *Summer student fellowships.* These are awarded for a period of 60 to 90 days and must have the approval of the institution and a direct faculty supervisor. Appointment usually begins June 1st and notification of the award is made in May.

The closing date for receipt of applications is March 1st. Applicants are required to submit project reports and abstracts at the conclusion of their award periods.

NATIONAL FOUNDATION, *800 Second Avenue, New York 17, New York.*

The National Foundation expects to broaden the scope of its research grants gradually. Its present areas of interests in research include poliomyelitis and related viral diseases, arthritis, congenital malformations, and disorders of the nervous system. Its present resources cannot provide support for all worthy research projects that might be considered pertinent to some part of the program. Initially, preference will be given to research in certain limited areas. These can be defined only in a general way, and the acceptability of borderline subjects will inevitably be subject to differences of personal judgment.

1. *Virus diseases.* Research on the enteroviruses will continue to be supported substantially as it has been in recent years. The National Foundation will also continue support of basic studies on virus genetics, and on host-cell-virus interactions in general. The Foundation cannot undertake to finance the establishment or maintenance of virus diagnostic laboratories.

2. *Arthritis.* Preference will be given to research on rheumatoid arthritis and closely related diseases, such as lupus erythematosus; etiology, pathogenesis, pathology and serologic manifestations, treatment and prevention of after-effects.

3. *Congenital malformations.* The Foundation is interested in the etiology of congenital malformations in general, and particularly in those resulting from viral or other infections of the mother during pregnancy. Support for clinical investigations will be restricted to those dealing with hydrocephalus, encephalocele and spina bifida. Support cannot be offered for research on injuries sustained at birth by infants whose intrauterine development has been normal, nor for research in the field of mental disturbances of congenital origin.

4. *Central nervous system disorders.* The main interests in this field are in those disorders that either are congenital or result from virus infections.

Basic research. Grants may also be made for basic research, not directly concerned with any of the disease entities listed above, but offering a reasonable hope of yielding information that will be pertinent to some of the problems.

NATIONAL RESEARCH COUNCIL, *2101 Constitution Avenue, Washington 25, D.C.*

The National Research Council has been entrusted with the funds and the authority to provide for predoctoral and postdoctoral fellowships which will promote training of talented individuals in research in educational and research institutions of the United States. These fellowships are awarded to persons who give high promise of achievement or who have demonstrated a high order of ability in research. Applicants must be citizens of the United States or Canada; their qualifications must fit them for ordinary fellowships of one year's duration or senior fellowships of three years' duration.

The Medical Fellowship Board of the National Research Council administers several fellowships designed to afford special opportunities for education and development for persons who are preparing themselves for an investigative career in the medical sciences. The two that are pertinent to this listing are the Rockefeller Foundation Fellowships in the Medical Sciences and the Lilly Research Laboratories Fellowships in the Medical Sciences. The specifications for both are the same:

The fellowships are ordinarily limited to individuals who are not more than 30 years of age. Applicants must have the degree of Doctor of Medicine or Doctor of Philosophy or equivalent experience and achievement in research. They are expected to devote the fellowship period to research in the basic medical sciences. Appointments are made for one year but applications for renewal will be considered. The basic annual stipend is $3,300, and additional allowances are made for dependents.

NATIONAL SCIENCE FOUNDATION, *Washington 25, D.C.*

The National Science Foundation Act of 1950 authorizes and directs the Foundation "to initiate, and support basic scientific research in the mathematical, physical, medical, biological, engineering, and other sciences, by making contracts or other arrangements (including grants, loans and other forms of assistance) for the conduct of such basic scientific research."

Mindful that its creation was in large part a product of the vision of American scientists, the Foundation has attempted to establish policies for the planning and administration of its basic research program that are consistent with its responsibilities as a member of our national scientific community and as an agency entrusted with the stewardship of public funds.

The Foundation's approach to the administration of grants for basic research rests on the belief that institutions and scientists alike wish to share, with the Foundation, responsibility for the administrative, financial, and scientific integrity of the program.

The Foundation considers all requests for the support of basic research, regardless of source. However, as a formal proposal is in most instances submitted by an organization on behalf of the principal investigator, research proposals normally are initiated by the scientist interested in doing the work, and if desired may, prior to formal submission, be the subject of informal discussions between the scientist and the Foundation staff, either by letter or in person.

Research proposals may be submitted to the Foundation at any time. However, for certain programs and fields of science, the Foundation may announce closing dates for the receipt of proposals to be considered during a particular time period. Information regarding the existence of such dates may be obtained by inquiry of the Foundation. Because of the nature of the program, the review and approval process, and statutory requirements, several months normally elapse between the receipt of a proposal and the issuance of a grant. Every effort will be made to reach a decision promptly, and to inform the organization and the principal investigator of the decision as soon as possible.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS, *1790 Broadway, New York 19, New York.*

The National Society for the Prevention of Blindness supports research projects, primarily directed to laboratory and clinical research in diagnosis, treatment and prevention of eye diseases and defects. There is no fixed dollar amount of the grants. The grants are made to universities, teaching hospitals and eye laboratories for a one-year period. Renewal may be requested at the end of the year by submitting a new application. Progress reports are required annually, including a financial statement. The deadline for applications for grants is April 15th.

NATIONAL VITAMIN FOUNDATION, *149 East 78th Street, New York 21, New York.*

The recurrent major interest of the National Vitamin Foundation is in the support of research, preferably on man, most likely to advance understanding of the diverse metabolic functions of the vitamins. It believes that procedures and facilities now are available to permit (1) the profitable exploration of those nutritional and metabolic conditions and relationships which are altered in both patients and laboratory animals with mental aberrations, and (2) the investigation of the effects of neuropharmacologic agents on nutritional status. It is of the opinion, also, that in many instances undesirable side-reactions to drugs may have common denominators in susceptible individuals, and that the basic faults may be ones of nutrition and metabolism. The Foundation wishes to encourage research on vitamin nutrition and metabolism in the areas of (1) mental health and (2) side-reactions due to drugs, and, therefore, invites applications for grants-in-aid of such research from interested and qualified investigators.

NUTRITION FOUNDATION, INC., *99 Park Avenue, New York 16, New York.*

Research projects supported by the Nutrition Foundation grants fall within the following main areas of activity:

1. Human requirements of individual nutrients.
2. Origin, function and measurement of individual nutrients.
3. Maternal and infant nutrition.
4. Public health problems in nutrition.
5. Educational projects.

The advanced training of young scientists is regarded as an important part of our grants program. Applicants should have programs which include training of graduate and postdoctorate students.

As an aid in determining whether formal application should be filed, it is suggested that initially a letter containing a brief description of the proposed project should be sent to the Executive Director of the Foundation to obtain his informal comments.

Application should be made by the investigator in charge of the proposed project who should be a member of the permanent staff of the institution to which the grant would be made and at which the work would be conducted. Applications received are evaluated by our Scientific Advisory Committee and are then referred with recommendations to the Board of Trustees. Grants are approved by the Board for initiation as of January 1st and July 1st each year. Applications should be received by September 1st for grants beginning January 1st and by February 1st for grants beginning July 1st.

OFFICE OF EDUCATION, *Department of Health, Education and Welfare, Washington 25, D.C.*

The Office of Education provides support for research of significance to education through its Cooperative Research Program. The purpose of this program is to develop new knowledge about major problems in education or to devise new applications of existing knowledge in solving such problems.

The Office receives proposals for specific research projects from staff members in institutions of higher education or in State departments of education. All proposals are submitted for review to the Office of Education Research Advisory Committee which is composed of nine research specialists and educators. If a proposal is recommended for approval and accepted by the Commissioner of Education, the Office negotiates a contract directly with the institution or agency for support of the project in terms of the funds available. The cooperating institution or agency is also expected to contribute to the total cost of the project, usually by providing some proportion of the professional services and/or facilities.

Applications may be accepted only from colleges or universities and from State departments of education. There are three submission deadline dates each year—September 1st, December 1st and April 1st, and the Research Advisory Committee meets to consider the proposals from 60 to 90 days following these dates. Applications should be submitted as early as possible preceding these deadlines to allow adequate time for processing.

OFFICE OF VOCATIONAL REHABILITATION, *Department of Health, Education and Welfare, Washington 25, D.C.*

The purpose of the Office of Vocational Rehabilitation research and demonstration grant program is to provide partial support for research projects, demonstrations, and projects providing special facilities and services which hold promise of making a substantial contribution to the solution of vocational rehabilitation problems common to all of several states. The major purpose of the research grants is to increase and extend knowledge in order to resolve vocational rehabilitation problems that are common to all or several states. In carrying out this program, the objectives are to (1) stimulate research in the field of vocational rehabilitation, and (2) encourage the initiation of research by agencies and organizations in areas of vocational rehabilitation needing exploration and investigation.

The objectives of grants for demonstration projects are to (1) establish pilot or experimental attempts to test or establish standards or methods of service that are practicable and effective for general application in the vocational rehabilitation program, and (2) provide special types of rehabilitation services in order to test their value in vocational rehabilitation and to provide information on costs, methods of administration, and methods of providing services or rehabilitation techniques.

The primary objective of grants to establish special facilities or to provide special services is to overcome deficiencies in vocational rehabilitation services which prevail on a "regional" basis (three or more States) and which are the result of a lack or inadequacy, of special facilities such as workshops, rehabilitation centers and the like. Projects to provide special services or to establish a special facility with the primary purpose of providing services to the disabled must meet the "regional" criterion, i.e., must be organized to serve the disabled from three States or more in each of which there is an evident problem because the special facilities required to provide the services are not available or are not adequate for the purpose.

Beginning July 1, 1957, the Office of Vocational Rehabilitation, as part of its research and demonstration grant program, started accepting applications for grants to provide part of the cost of demonstration projects in the vocational rehabilitation of certain groups of severely disabled persons. The major purposes of these selected demonstration projects are to (1) accelerate vocational rehabilitation services to severely disabled persons; (2) provide for prompt and widespread application of knowledge and experience acquired in the OVR research grant program, and (3) test, insofar as possible, the application of the research findings under varying circumstances in different parts of the country. Projects designed primarily to expand an established program of services, or solely to enlarge a rehabilitation facility or sheltered workshop, would not usually be eligible for consideration under this program.

OPHTHALMOLOGICAL FOUNDATION, INC., *111 East 59th Street, New York 22, New York.*

This Foundation supports projects in ophthalmic research. The amount of the financial support varies according to the request and the organization's ability to aid.

PHARMACEUTICAL MANUFACTURERS

Most of the major drug firms support a varying amount of outside research in both basic and applied fields. Some have established formal trusts for this purpose, and others provide funds from current appropriations. Generally their policies are variable and chief consideration is given to the merit of an individual proposal.

PUBLIC HEALTH SERVICE, *Bethesda 14, Maryland.*

The research arm of the Public Health Service

is the National Institutes of Health. The National Institute of Neurological Diseases and Blindness (NINDB), one of the constituent Institutes, has the primary responsibility for research relating to disorders of vision.

NINDB offers financial support by means of grants and awards to institutions and to individuals to stimulate new investigations in the neurological and sensory fields and to aid in training personnel especially for academic careers in these fields. Grants to institutions include:

1. *Research grants.* These are designed to support, encourage and expand research, thereby increasing knowledge of the cause, prevention, and treatment of sensory and neurological disorders. They are available to non-federal institutions for medically-oriented research conducted by qualified basic and clinical scientists.

The number and amount of this type of grant to an individual or institute is not limited. Applications are judged on the scientific merit of the proposal, the qualifications of the principal investigator, and the adequacy of facilities. Duration of the grant may range from one to several years and it is subject to repeated renewals. The usual request is for a five-year program.

2. *Training grants.* These are designed to support training programs preparing basic and clinical scientists for research and training careers in neurological and sensory fields. Trainees under such a grant must have an M.D., Ph.D. or equivalent degree. They are selected by the institution on recommendation of the program director.

Applications are reviewed on the basis of qualifications of the program director, adequacy of facilities, and the potential for training career investigators. Funds may be used to pay trainee stipends, salaries to training staff, and cost of necessary supplies—all in accordance with the policies of the grantee institution.

Stipends, which also are set by the institution, generally may not exceed $4,500.00, $5,000.00 and $5,500.00 for each of three succeeding years, with an additional allowance of $500.00 for each dependent. Programs usually are approved for three or more years and are subject to repeated renewal. The average request is for five years.

3. *Teacher-Investigator development grants.* These grants may be awarded to United States medical schools, university graduate schools, and schools of public health in behalf of the U.S. citizens or those who have filed a Declaration of Intent, who will engage in research and teaching as full-time faculty members of the institution.

The Teacher-Investigator must have had at least five years of postdoctoral training related to his chosen field. He should have given unmistakable evidence of teaching and research ability and should possess the personal qualities necessary for the development of academic leadership.

4. *Career research professorship grants.* These grants are awarded to institutions in the United States in behalf of United States citizens or those who filed a Declaration of Intent. They are intended (1) to establish additional full professorial positions in medicine, dentistry, public health and related areas; (2) to assist in recruiting into these positions persons with the most thorough training and the greatest aptitude and promise for productive careers in research and teaching, and (3) to provide further incentive for the choice of a career devoted to research and teaching on the part of young scholars. Each institution may submit up to four applications in any one year.

Career Research Professors will be selected for support on the basis of demonstrated capacity to pursue with distinction a professorial career in independent research and teaching. The awards will, in general, be for full professors but may, in exceptional circumstances, be extended to associate professors.

These grants will be awarded initially for five years of support and are renewable at five-year intervals unless other funds, providing stable career support, become available.

The sponsoring institution shall determine the yearly salary level to be requested, up to a maximum of $25,000.00 per annum. In addition, the grantee institution may request an allowance up to $10,000.00 a year for the allowable expenses of the research professor, including the institution's portions of established retirement payments, social security, and other fringe benefits.

Awards to individuals include:

1. *Postdoctoral fellowships.* The purpose of these awards is to increase the number and skills of basic and clinical scientists to qualify them to conduct independent research. Applicants must have—or be about to receive—the M.D., Ph.D., or an equivalent degree. They must be citizens of the United States or must have filed a Declaration of Intent.

Awards may be made for from one to three years. Stipends are $4,500.00 for the first year, $5,000.00 for the second year, and $5,500.00 for the third year. An additional yearly allowance of $500.00 is given for each dependent. Training in the United States may be at any qualified institution (including Government research facilities). Training may be taken abroad when the kind or quality of guidance available is particularly adapted to the proposed study.

2. *Special fellowships.* These provide the opportunity for advanced study or highly specialized training to basic and clinical scientists preparing for *academic careers* in teaching and investigation. To qualify, applicants must be American citizens or have filed a Declaration of Intent. In addition to an M.D., Ph.D., or equivalent degree, three or more years of postdoctoral training or experience pertinent to the training desired are required for eligibility.

Training may be taken in the United States or abroad at any institution qualified to provide suitable direction and facilities for the proposed study. Awards are made for not less than nine months at one institution, and are subject to renewal up to a total of 60 months. Stipends, which are determined individually, range from $6,500.00 to $17,500.00 annually.

Detailed information about the policies and proce-

dures governing these grants and awards is available from the *National Institute of Neurological Diseases and Blindness, National Institutes of Health, Bethesda 14, Maryland.*

RESEARCH TO PREVENT BLINDNESS, INC., *598 Madison Avenue, New York 22, New York.*

Research to Prevent Blindness, Inc., was established in 1960 to stimulate and finance an increased amount of basic research in the causes of blindness. Its purposes are to:

1. Develop and expand existing research facilities at leading ophthalmologic research institutions throughout the country.
2. Broaden present research programs at these institutions and stimulate new promising programs.
3. Enable gifted research physicians and other scientists to make their careers in ophthalmic research.
4. Co-operate with all private and public agencies which can help advance the cause of research to prevent blindness.
5. Focus broad public attention on the present lack of eye research and the need for urgent remedial measures.

Research to Prevent Blindness, Inc., decided, following a March, 1960, meeting of leaders in the field of research, that it could best and most expeditiously serve the immediate needs for ophthalmological research without duplicating the programs of other agencies. It was decided to advance its objectives by:

1. Making unrestricted grants to research institutions to be used at the election of the director.
2. Awarding grants to institutions for a portion of the funds needed to match approved Federal grants for construction of research facilities, and assisting them in raising the balance.
3. Providing grants to institutions to attract and support career investigators over an extended period at a salary level to enable them to conduct imaginative and effective research.
4. Continuing to advocate adequate Congressional appropriations for an expanding program in the blinding diseases conducted by the U. S. Public Health Service, and for research programs, projects and training activities in medical schools.

Support for this program will come from contributions from the organization's board of trustees and other individual donors, from grants from foundations and corporations, and from special events.

It is the organization's intention to develop new sources of support—to assure that financial assistance is not diverted from existing agencies serving the blind.

In May, 1960, the new organization awarded grants of $5,000.00 each to 11 institutions from funds provided by the trustees.

ROCKEFELLER FOUNDATION, *49 West 49th Street, New York 20, New York.*

The Rockefeller Foundation is primarily a grant-making organization. Except to a limited extent—presently in virology and agriculture—it does not itself engage directly in research or operations. Its charter purpose is "to promote the well-being of mankind throughout the world." The Foundation seeks to advance this purpose through grants to universities, research institutes, and other qualified agencies conducting work within the scope of the Foundation's program. Both the income and principal of the Foundation's general fund are available for appropriation. Responsibility for the fund and its expenditure rests with the trustees.

In the area of the medical and natural sciences, emphasis is upon professional education and upon research in the life processes, including the biological, chemical and physical sciences as they contribute to an understanding of the living world. Professional education includes general support to medical schools, nursing schools and occasionally schools of public health. Much of this aid, especially that of research, is channeled to institutions in other counrties. Studies of the quality of medical care and techniques for its improvement are supported in selected instances. The Foundation also conducts research in its central laboratory and the field laboratories on certain insect-borne viruses of importance to human health, and supports virus studies in other institutions.

UNITED CEREBRAL PALSY FOUNDATION, *321 West 44th Street, New York 36, New York.*

This Foundation is interested in supporting research in neuro-ophthalmology having relation to cerebral palsy and associated neurologic and ophthalmologic disorders. Deadlines for applications are September 15th and March 15th each year, and funds are made available for January 1st and July 1st. Complete information may be obtained by writing to the Director of Research, Research and Educational Foundation.

VETERANS ADMINISTRATION, *Washington 25, D.C.*

Funds appropriated by Congress for support of the Medical Research Program are distributed to Veterans Administration field stations with established research activities, for support of the research projects of Veterans Administration scientists—physicians, biochemists, enzymeologists, microbiologists, physiologists, radiobiologists, etc. In addition, a very modest extramural research program has been supported. Requests for project support are made directly to the Research Service, Central Office, and are submitted to the Committee on Veterans Medical Problems for feasibility study and approval.

SOCIETY PROCEEDINGS

EDITED BY DONALD J. LYLE, M.D.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

452nd Meeting, January 20, 1960

DR. BRENDAN LEAHEY, *presiding*

TREATMENT OF INTRAOCULAR TUMORS WITH DIATHERMY

DR. I. OKAMURA: Retinoblastoma and hemangioma of the choroid are two of the intraocular tumors most amenable to diathermy treatment. The diagnosis of retinoblastoma is usually not difficult, the first eye having been removed for an obvious neoplasm. One may encounter difficulty in locating all the lesions. The diagnosis of hemangioma of the choroid is more difficult and if there is uncertainty and the differential diagnosis is that of malignant melanoma, it would be safer to enucleate the eye. The shape of a hemangioma is relatively flat, the color is pink, and with pressure on the globe the tumor may be made to blanch. The hemangiomas are usually located next to the disc or in the macular area. They may be bilateral and complicated by retinal detachment.

The diathermy treatment of retinoblastoma requires that the tumor be completely destroyed, whereas in hemangiomas partial destruction may cause the tumor to regress. The technique requires localization of the lesion under ophthalmoscopic control with a surface electrode. Various lengths of needles must be available. Twelve to 15 applications may be necessary. When gas bubbles form, they are an indication to stop the diathermy and perforate in another location. The translucent tumor becomes more opaque. Postoperative monthly ether examinations are necessary. The central necrotic tumor decreases in size and, if the therapy has been adequate, a flat scar results.

The diathermy treatment of hemangiomas is essentially the same as outlined except that one-half the needle electrode applications are sufficient to cause the tumor to regress.

OCULAR MANIFESTATIONS OF CERTAIN METABOLIC DISEASES IN CHILDREN

DR. S. LIEBMAN: The discussion was limited to metabolic diseases in children which are of an inherent nature. There are several large groupings and subdivisions:

I. *Errors of carbohydrate metabolism.* A. Diabetes. There is little new about the ocular manifestations of diabetes. The development of diabetes may be precipitous in children and the ocular manifestations extremely severe and fulminating.

B. Galactosemia. This is defined as a genetic defect in the ability of the body to convert galactose into glucose. Cataracts develop in about 50 percent of the cases. The earliest changes appear as a highly refractile annular zone around the fetal nucleus, giving the lens an "oil drop" appearance. Later zonular and cortical opacities develop. Early diagnosis is obviously important since restriction of galactose intake by elimination of milk usually causes rapid improvement in the clinical picture, and there may be reversal of the cataract formation if it is still in the "oil drop" stage. The disease is believed due to the absence of the enzyme uridyl transferase, which is usually present in all body cells and which is necessary to convert galactose into glucose.

C. Hurler's disease (gargoylism). This is known to be a disorder of mucopolysaccharide metabolism. The most striking ocular manifestation is the classical diffuse corneal haze which is usually bilateral and which occurs before the age of three years. There is interstitial fine-dot clouding of the cornea which can be seen best with the slitlamp. The deposits are yellow-gray, granular and in the deeper layers of the corneal stroma in the early stages. The epithelium and endo-

thelium are usually spared and there is no vascularization. The most pronounced changes in the cornea are confined to the region of Bowman's membrane. The corneal diameters may be increased. The differential diagnosis must include congenital glaucoma.

II. *Errors in protein metabolism.* Cystinosis (Fanconi's syndrome). This is another rare disorder and occurs almost entirely in children. It is due to a hereditary in-born error in the metabolism of many amino acids. A diffuse haziness of the cornea is caused by thousands of tiny highly refractile crystals noted by the microscope.

III. *Errors in fat metabolism.* The diseases are due to a primary constitutional defect in lipid metabolism as revealed by chemical and histochemical studies.

A. Tay-Sachs disease. The classical fundus picture of a cherry-red spot is due to a cytoplasmic accumulation of a complex glycolipid in the ganglion cells of the retina. The especially abundant ganglion cells in the macula cause the opacity to be most striking in this region. Some vision may remain until 18 to 24 months of age.

B. Niemann-Pick disease. A similar cherry-red spot in the macula may be seen in one quarter to one half of the cases. Optic atrophy, blindness, strabismus, and paralysis of vertical gaze have been described. A prominent feature is a widespread intracellular deposition producing the "foam cells."

C. Gaucher's disease is similar to Niemann-Pick disease. There is a deposition of the lipid kerasin in the lymphatic and hematopoietic apparatus.

D. Xanthoma tuberosum is a form of familial cholesterolemia. Ocular findings include arcus juvenilis and xanthelasmas of the eyelids. There is an accumulation of lipid material in the histiocytes.

IV. *Diseases of varied etiology with occasional secondary lipid disturbance.* A. Eosinophilic granuloma, Hand-Schüller-Christian syndrome and Letterer-Siewe disease. The diseases may show a disorder of the bony orbit, granulomas in the soft tissue of the orbit, and exophthalmos.

B. Nevoxanthoendothelioma (xanthoma disseminatum). There are extensive lesions of the skin associated with granulomatous infiltrations of the iris. This occurs only in infants, and there may be spontaneous hemorrhage into the anterior chamber.

V. *Endocrine disorders.* A. Hypoparathyroidism-parathyroid disease itself is rare in children. It may occur on an idiopathic basis and lens changes characterized by small discrete angular colored crystals may appear. The serum calcium is usually below 7.0 mg. percent. The administration of calcium will not affect the progress of the cataracts. They are said rarely to interfere with vision.

B. Pseudohypoparathyroidism. Severe chronic kidney disease produces disturbed calcium metabolism and characteristic bilateral lenticular opacities.

C. Cretinism.

VI. *Disorders of heavy metal metabolism.* A. Wilson's hepaticolenticular degeneration is an excellent example of a hereditary familial error in heavy metal metabolism. Chemically, one finds a low serum copper and a reduction in serum copper oxidase. The Kaiser-Fleischer ring is the consistent clinical feature. It is described as golden in color but may be brown or grayish green; when well developed it is two mm. in width. It is seen in the deepest layers of the corneal periphery. It is composed of granules of deposited copper and the pigment is definitely within Descemet's membrane.

Alpha chymotrypsin in cataract surgery

Dr. M. S. Wiedman: The clinical and experimental aspects of the use of alpha chymotrypsin in cataract surgery were reviewed. Postoperative complications were noted not to be significantly increased. Wherever striate keratitis was observed it was probably due to protracted fluid infusion. The author recommended restricting its use to the over 20-year age group. Discussers of the paper were enthusiastic about the use of this drug.

Discussion. Dr. Beetham: Sixty cases

had been tried with the use of the enzyme and, in all instances, Dr. Beetham felt he had met with great success. No capsules had been broken, no vitreous had been lost, striate keratitis was practically absent.

DR. T. CAVANAUGH: Having used the erisophake for a number of years Dr. Cavanaugh has reverted to the Verhoeff forceps and the use of the enzyme. Frequently the forceps is not even required.

DR. E. DOWLING: At the Rhode Island hospital 500 cases have been observed in which the enzyme was used. The effort required for delivery of the lens and the number of complications have been reduced markedly.

PROGRESS REPORT ON SCHOOL VISION TESTING

DR. A. E. SLOANE: The New England Ophthalmological Society was a pioneer in appointing a committee for the study of a school vision program. Its investigations and standards have been followed throughout the country. There have been many testing devices but the Massachusetts Vision Test still remains extremely reliable and practical because it includes a study of the visual acuity, hyperopia, and heterophoria. Studies for stereopsis, binocular vision, and color vision were not included in the test because they appeared to be time consuming and added to the complexity of the test. In addition, a larger number of referrals than is necessary would be made.

The results of these studies have shown that there is less isolation of students in special classes and more integration into regular classes with the aid of special books and visual aids for those who are visually handicapped. A further detailed report of the past 25 years of these studies is forthcoming.

ELECTRO-OCULOGRAPHY

DR. C. KUPFER: Electro-oculography is a technique whereby the movements of the eye are recorded by means of the corneal-retinal potential of the eye. It is an outgrowth of the early investigation of the electroretinogram. It records the movements of the entire globe, whereas electromyography records the electrical activity of the individual muscles. The direct current changes rather than the alternating current changes are important. It is hoped that these techniques will be used as additional diagnostic tools in selected problems of ocular motility.

NYSTAGMUS SURGERY

DR. A. KESTENBAUM: Nystagmus is now divided into three groups based on disturbances of the fixation, the vestibular, and the gaze mechanisms. Since 1950 we have had a new era with regard to the treatment of nystagmus. Nystagmus surgery is undertaken for two reasons: (1) the patient sees less because of his nystagmus, and (2) he turns his head so that in the new position there is less nystagmus.

Dr. Kestenbaum indicated on a diagram that there was a neutral zone which is the optimum position of the eyes. The purpose of the surgery is to move the eyes in the direction of the worst nsytagmus, that is, the direction of the quick phase. Measurements are made with a mm. rule, noting at the limbus the amount of change in position when the eye is moved to the position where the eye is exhibiting the least nystagmus. If the distance measured is five mm. the eye must be rotated five mm. into the opposite direction. Dr. Kestenbaum insists that this will require a five-mm. resection and a five-mm. recession of the antagonist on this eye. It must be duplicated in the other eye. One mm. of limbus rotation equals eight prism diopters. This figure must be kept in mind and accounted for in cases of strabismus.

Two types of cases are specific indications for surgery. The first is an asymmetrical nystagmus present from infancy associated with a head tilt. The second is that which occurs in older people who do not see well in the primary position because of the nystagmus.

Dr. Kestenbaum commented on latent nystagmus which occurs when an eye is covered while fixing with the other eye. He has observed a severe nystagmus develop in patients who have lost one eye. These cases are

good subjects for operation. Turning the eye in the direction of the quick phase will reduce the amount of nystagmus in the primary position.

Nystagmus in albinos might be eliminated according to Dr. Kestenbaum, if pinhole goggles were placed on the infant for the first four months so that a sharp image could be received on the macula and aid in the development of the child's fixation mechanism.

In pendular nystagmus which cannot be made to disappear, the recommended methods of surgery cannot be applied.

D. Robert Alpert,
Recorder.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

May 4, 1959

DR. ARTHUR LINKSZ, *presiding*

AQUEOUS VEINS AND CYCLODIALYSIS

DR. KARL W. ASCHER: The detection of aqueous veins and observation of their behavior in different types of glaucoma and after various manipulations have given answers to many questions. They offered the first clear demonstration that there is continuous production and circulation of aqueous as against the previous stagnation theory, showed that almost all glaucoma is due to retention rather than overproduction of aqueous, and provided the foundation for tonography.

Cyclodialysis is often a satisfactory operation for chronic simple glaucoma, either as a primary procedure or when other surgery has failed.

Three points in the original Elschnig technique were emphasized: (1) massage over the closed lids to lower intraocular pressure preoperatively, (2) the use of a bent but not curved cyclodialysis spatula, and (3) pressure on the limbus opposite the operative site exerted by the assistant to prevent hemorrhage.

Modifications of the original technique which make the operation safer are: (1) the pupil should be made miotic; (2) the upper temporal quadrant, rather than the lower, is preferred so that any hemorrhage will drain away from the operative site and to keep the cleft open by the pull of the weight of the lens; (3) a fine-toothed forceps should be used to grasp the sclera between limbus and the incision for fixation; (4) the incision should be bevelled 45 degrees forward; (5) after the spatula has entered the sclera it is preferable to enlarge the dialysis by partially withdrawing the spatula and reinserting it at a slightly different angle, repeating this procedure at increasingly greater angles until the two extreme thrusts are made 180 degrees from each other. This is safer than enlarging the dialysis by upward and downward sweeps of the spatula while the tip is in the anterior chamber, whereby iridodialysis or folding of the iris and hemorrhages may be induced.

HUMAN OCULAR MYOGRAPHY

DR. ARTHUR JAMPOLSKY described the technique and uses of electromyography. Needle electrodes are placed in the muscle, the amplified signal from either a single fiber or a group is fed to an oscilloscope which is then photographed by a kymographic camera. It is too complicated to be used in routine clinical practice, but is useful in research and in specific neurologic situations.

An example of its research value is the light it sheds on the problem as to whether intermittent exotropia is due to "divergence spasm" or simply a relaxation of convergence. By taking simultaneous records of all four horizontal rectus muscles at the instant of divergence, a picture is obtained of relaxation of the convergence mechanism, rather than activation of the divergence mechanism. Although there is obviously a divergent mechanism, it appears that, when an intermittent exotrope becomes manifestly exotropic, it is a return to the fusion-free position via relaxation of convergence.

Alan H. Barnert,
Corresponding Secretary.

AMERICAN JOURNAL OF OPHTHALMOLOGY

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THE NEW OPHTHALMIC HOSPITAL OF ST. JOHN IN JERUSALEM

In a previous note to THE JOURNAL (46: 228, 1958) the story was told of how, about A.D. 400, the Nations of the West set up a hospice to look after the needs of the Christion pilgrims who journeyed to the Holy Land, how the hospice was built again by the Emperor Charlemagne in A.D. 800, and how at the end of the Crusades the Hospitallers of the Order of St. John were expelled from Jerusalem in 1187 by the Saracen general, Saladin the Great, and during the following six centuries established hospitals in Cyprus, Rhodes and eventually Malta. The story was also told of how in 1883 the Order of St. John in England resolved to revive its old association with the Holy Land and

opened a new ophthalmic hospital in Jerusalem; this again was largely demolished in the First World War and in 1948 was finally lost to the Order in the Israeli-Arab war. Thereafter, as a temporary measure, because of the desperate need of the population for ophthalmic help, two old houses in the Arab city of Jerusalem were converted into a temporary hospital.

In the intervening years this converted building carried on the traditions of the past, but under technical difficulties that had to be seen to be believed. To get from one ward to another courtyards had to be crossed and little flights of stairs had to be negotiated, for few parts were on the same level, the patients were carried from the theatre to the wards on sheets, the sanitation was not up to modern standards, and the maintenance of sterility was a headache; but the garden was beautiful. From the upper windows or the roof, the Church of the Holy Sepulchre and the Dome of the Rock were seen close at hand, and in the near distance the Garden of Gethsemane and the Mount of Olives. In the rambling building 45 beds were housed, more than 160,000 patients were seen and over 3,000 surgical operations performed each year.

It was obvious that such a makeshift establishment could only be temporary. But the age-old tradition of the West with the city of Jerusalem had a strong appeal to the Order, while the giving of medical aid to an underprivileged people greatly in need was a duty that could not lightly be allowed to lapse. A new site was therefore procured by the Order, a new and sixth hospital with its ancillary buildings was planned; and now it is opened and working. The first buildings to be opened were the research laboratories (1956), which initially housed the team of workers of the Medical Research Council of Great Britain who analyzed the organismal flora of ocular infections in Jordan and contributed notably to the virology of trachoma.

The ceremony to mark the opening of the main hospital on October 11, 1960, was an

Fig. 1 (Duke-Elder). The Hospital of St. John in Jerusalem, with the flag of St. John flying from the tower.

imposing event. Some 135 members of the Order travelled out from Great Britain with representatives from the Priories of Canada, South Africa, and Australia, the officers and members of the Chapter-General dressed in their black robes adorned with the eight-pointed white cross, the banners and the sword-bearer, all were there—all the panoply of the Middle Ages seen for the first time by the people of Jerusalem since the Crusaders departed. And the people of Jerusalem themselves and of the surrounding country turned up in strength. The Order, of course, takes no cognizance of class, race or creed; and it is interesting that at the Service of Thanksgiving at the Cathedral in Jerusalem no fewer than 15 creeds were represented. The autumn weather in Jerusalem (3,000 feet above sea-level) is warm and sunny; and of junketing and sight-seeing there were plenty, while the Jordan Arab Army in their picturesque uniforms provided the guards of honor, the music and the buns. Thus was the continuity of thirteen and a half centuries maintained.

The hospital buildings, standing in a large garden enclosure (complete with the only tennis court in the city), are situated on a commanding position; from the tower from which the centuries-old flag with the cross of St. John constantly flies (fig. 1) are seen to the east the hills of Moab across the Dead Sea, and to the west the State of Israel.

Fig. 2 (Duke-Elder). The Opening Ceremony. The end of the procession leaving the cloisters at the back of the hospital; cloisters have been a tradition of the hospitals of St. John since A.D. 600. The members of Chapter-General are in the robes of St. John. The picturesque uniforms are those of the Jordan Arab Army and the nurses are on the balcony.

Within the compound, in addition to the hospital itself, are the laboratories with their animal house, the house of the Chief Surgeon, the Matron's residence and Sisters' Home, and a bungalow for visitors—called the "V.I.P. bungalow"—so that distinguished visiting ophthalmologists or virologists (from America?) may be suitably housed. Across the road are two flats available for medical staff.

The hospital itself is simply planned on modern lines, its corridors and wards pleasantly painted in pastel shades. The central block contains the wards, behind which is a theatre block (all modern construction) and the kitchens (all-electric), the west wing accommodates the immense out-patient department, the administration offices, a conference room and library, a recreation room, lecture rooms, a nurses' school and a school for the blind, and in the tower are the residents' quarters; the east wing is the nurses' and orderlies' home. The surgical staff consists of two surgeons, a registrar and two internes (two British and three Arab); the senior nursing staff is British, the remainder Arab.

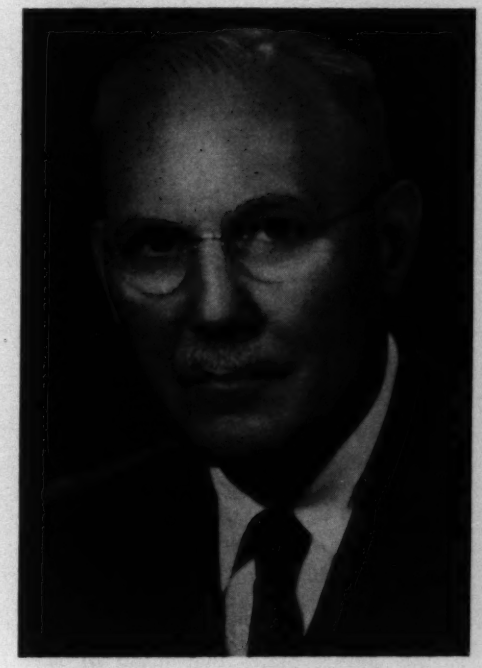
The day after moving from the old to the new hospital the Arab cooks, deserting their primitive calor gas stoves, cooked a delicious meal in the modern all-electric kitchen, the ladies of the laundry continued to scrub on their old-fashioned boards while electric washing machines and spin-driers stood despised beside them, and the operating theatre filled with clouds of steam because the thermostat in the control panel of the sterilizers had been broken on its way out from England. Nevertheless, on the day of the opening a crowd of patients was seen in the cloistered courtyard, on the following day the first in-patient was in bed, and during the next week all 75 beds were filled. The hospital provides the only treatment for eye diseases in the whole region where the population is poor and disease distressingly rife, and it serves the multitude of refugees that in their hundreds of thousands get ill and become well, pathetically live and die, on both banks of the Jordan River. The opportunities for ophthalmic practice, medical and surgical, are therefore superb. Not only does the hospital supply this vital local need, but it draws serious cases from the surrounding countries in the Middle East, acts as the

only training school for eye-nursing in the area and provides a superb training ground for the future specialist with material for research in well-equipped laboratories. Nor, it is hoped, will these training facilities be confined to the Middle East. Moorfields Eye Hospital in London has introduced a scheme whereby postgraduates can be seconded to Jerusalem (for a minimum period of six months) where the wealth of clinical material and particularly of surgery will be of immense value to them at a stage in their development when surgical experience is often difficult to get at home. A similar arrangement has been sanctioned by the American University of Beirut. When the new American Society of St. John becomes active the same facilities will be made available to the young specialist from the United States of America.

Stewart Duke-Elder.

OBITUARY

CLARENCE ARCHIBALD VEASEY, Jr. (1895-1960)



CLARENCE ARCHIBALD VEASEY, JR.

Clarence Archibald Veasey, Jr., was born in Philadelphia, Pennsylvania, on November 24, 1895, and died August 22, 1960, in Spokane, Washington, where the family had moved in 1909. He did his premedical work at Yale University and received the degree of Doctor of Medicine from the University of Pennsylvania in 1920. Dr. Veasey interned at Polyclinic and Presbyterian Hospital in Philadelphia and served his residency at the New York Eye and Ear Infirmary in 1920-1924.

In 1924, following certification by the American Board of Ophthalmology and by the Board of Otolaryngology, he began practice in the office of his victorian father, who was the former associate Professor of Ophthalmology at the University of Pennsylvania. He devoted most of his time to ophthalmology, and was a member of the American Ophthalmological Society (1940).

He will be remembered by many of the members of the American Academy of Ophthalmology and Otolaryngology from his popular instruction course: "On the dissatisfied refraction patient" and also by his frequent participation in the meetings of the Pacific Coast Oto-Ophthalmological Society. His 15 papers on various subjects in ophthalmology and otolaryngology attest that a physician, though not attached to a university center, but with a keen mind, sharp observation and sacrifice of time that could be used for recreation, also can make fine contributions to science in addition to being a successful practitioner. As one of the incorporators of the Spokane Medical Service Bureau, he did much for the interest of the public and of his colleagues at the difficult period of the recession in the early 1930's.

Artistic by nature, Dr. Veasey was more than an amateur in music and painting. He composed music for choirs and arranged Wagner's *Parsifal* for mixed chorus and orchestration. He was also creative in his fa-

vorite sport, sailing, as a cartographer. The best detailed map of the beautiful Coeur d'Alene Lake is the result of his painstaking endeavor. Spokane and the Inland Empire was enriched by the culture the father and son brought to Spokane. He is survived by his wife, a sister, and a son and daughter of his first marriage.

CORRESPONDENCE

Corneal-scleral needles wanted

Editor,

American Journal of Ophthalmology:

Would it be possible to place a request for corneal-scleral needles which have been used once or twice and then discarded to be collected for use in this hospital. We are referring particularly to those needles which can be threaded with fine silk. We have been told by one of our ophthalmologist friends in the United States that many of these needles may be used only one or two times and then discarded. We believe that these are useful a number of times and would like to try them. Perhaps such a request should be directed to operating room supervisors.

If it is possible to grant this request, the needles might be sent to Dr. B. Bronson, 97 Elm Street, Westfield, Massachusetts, who would then be responsible for getting them to us.

(Signed) O. A. Brown, M.D.,
Medical Superintendent,
Christian Hospital,
Taxila, West Pakistan.

Insurance forms and medical terminology

Editor,

American Journal of Ophthalmology:

A patient of mine has been paying extra on her health and accident policy for the past 10 years. At that time I performed bilateral iridectomies for recurring attacks of angle-closure glaucoma. Since the operations there has been no further trouble; her anterior chambers are deep and her angles are open without peripheral anterior synechias. The outflow and tension studies are well within normal limits, and there are no defects of vision, field or fundus. The insurance company has been unwilling to reduce the premium rate to normal and the diagnosis of glaucoma stands.

This situation is going to become more common as we do more surgery to prevent angle-closure glaucoma. In a case with narrow angles and positive dilatation provocative test, many of us perform peripheral iridectomies before an attack of acute glaucoma ever strikes. What diagnosis should be put on the insurance papers when an insurance company is involved? It would seem to me correct if we used a term such as "narrow iris angle" (anatomic). Someone may have a better suggestion but this at least would get away from the confusion bound to arise when the word glaucoma is used. In naming the operation all we need write is "peripheral iridectomy."

This suggestion of course is not made in the attempt to evade or cover up the true state of affairs but is actually an attempt to do just the opposite; namely, give the true state of affairs. These people simply do not have glaucoma. I believe that my patient, mentioned in the first paragraph, does not now have glaucoma and should not be paying the extra amount of her insurance.

Some insurance companies may object and there would be justification. Some sort of waiver pertaining to the eyes for perhaps a year might be the answer. There are possible complications from the surgery and this would protect the company. It does seem unjust, though, to use the term glaucoma when glaucoma has never existed and then have the patient saddled forever with this diagnosis.

Some of our patients come to us for the first time during an acute attack of angle-closure glaucoma in one eye. In this instance there would be no question as to how to fill out an insurance form in regard to this first

eye. If the fellow eye has never had an attack, shows no damage but does have a very narrow angle (as ordinarily is the case) how should we proceed? Most of us strongly urge peripheral iridectomy for the fellow eye. The same question arises now as to diagnosis and insurance terminology. Again I think my suggestion outlined above would be correct.

The subject is interesting and important since so many people now have health insurance. May I end by suggesting again that a term such as anatomically narrow angle be used in filling out insurance forms?

H. Rommel Hildreth, M.D.
Clayton, Missouri.

BOOK REVIEWS

IMPORTANCE OF THE VITREOUS BODY IN RETINAL SURGERY WITH PARTICULAR EMPHASIS ON REOPERATIONS. Edited by Charles L. Schepens. Saint Louis, C. V. Mosby Company, 1960. 226 pages, 130 figures, including four in color, three plates in full color, references, index. Price: $15.00.

This book reports the contributions and discussions of the Second Conference of the Retina Foundation, held on May 30 and 31, 1958. It is well edited, finely printed and beautifully illustrated.

Part one, moderated by P. Robb McDonald, takes up (a) the anatomic relationship of the retina to the vitreous body and to the pigment epithelium, presented by L. E. Zimmerman and B. R. Straatsma, and (b) physiology of the vitreous body by E. A. Balazs. These papers were discussed by S. R. Irvine, Hans Pau of Münster, West Germany, H. E. Thorpe, M. Shea and S. J. Bullington.

Part two, moderated by James H. Allen, is concerned with (a) pathologic findings after retinal surgery by T. R. Smith and is discussed by C. C. Teng, E. A. Balazs and S. R. Irvine; (b) clinical observations of vitreous changes by Karl Hruby of Graz, Austria; (c) ophthalmoscopic observations related to the vitreous body by C. L. Schepens. Discussion was continued by H. E. Thorpe and R. J. Brockhurst.

Part three, moderated by A. Edward Maumenee, concerned (a) vitreous implants by D. M. Shafer, discussed by M. L. Rosenthal, K. Hruby, T. R. Smith, Graham Clark, E. A. Balazs, T. P. Stratford, M. Shea and C. L. Schepens; (b) a method of scleral resection for retinal detachment, by D. K. Pischel, discussed by L. H. Pierce, W. G. Everett, M. L. Rosenthal, M. Shea, J. Sebestyen, T. P. Stratford, R. J. Brockhurst, C. L. Schepens, D. S. Johnson and H. M. Katzin.

Part four, moderated by D. K. Pischel, discusses (a) scleral buckling without excision and polyviol implant by Prof. E. Custodis of Düsseldorf, West Germany, the originator of the buckling operation (1949). It is discussed by A. Grignolo of Parma, Italy, with questions by D. K. Pischel, H. Pau, K. Hruby, A. E. Maumenee, M. Rosenthal, H. E. Thorpe, A. Schwartz, M. Berliner, D. M. Shafer, P. Cibis, P. R. McDonald, D. S. Johnson, W. G. Everett, T. R. Smith, R. J. Brockhurst, C. D. J. Regan, I. Baras, F. A. Perretin, R. E. Kirsch, J. Contretas and G. B. Corcoran, Jr.; (b) scleral buckling procedures with excision by I. D. Okamura, discussed by P. R. McDonald, H. E. Thorpe, D. K. Pischel, A. Grignolo, I. Baras, N. F. Thorlakson, M. G, Ross and C. L. Schepens.

Part five consists of conclusions drawn by the editor, C. L. Schepens, who very neatly sums up the important points of these significant papers, and ties in the experimental and histopathologic studies with clinical experience, in which he excels.

All ophthalmic surgeons should avail themselves of the privilege of owning and studying this book. Even the ophthalmologist who rarely operates upon a retinal detachment patient will profit very much.

As is often the case, the informal discussions of the scientific paper succeed in bringing out many important facts that might otherwise not have been noted.

Derrick Vail.

LEHRBUCH DER AUGENHEILKUNDE. Edited by M. Amsler, A. Brückner, A. Franceschetti, H. Goldmann and E. B. Streiff. Basle, Switzerland, S. Karger, 1961, edition 3. (United States representative Albert J. Phiebig, P.O. Box 352, White Plains, New York.) 1011 pages, 400 illustrations, many in color, index. Price: $36.00.

The first edition of this extraordinarily good textbook of ophthalmology appeared in 1948 under the same editorship of internationally known authorities, all from Switzerland, as this third edition. Developed as the direct result of the shortage of German textbooks during World War II, it immediately became popular among all German-reading students of ophthalmology. In 1954 the second (enlarged) edition appeared and had wide appeal.

This new edition (third) has as its collaborators, authors whose names are widely known and respected. There are 16 of these "Mitarbeiters," all except three are Swiss. These three are Henkes of Rotterdam, Süllman of Münster, West Germany, and the perennial old master, Weve of Utrecht.

It is truly extraordinary that a small country such as Switzerland has produced so many outstanding ophthalmologists, particularly in recent times. This industrious, original and exciting "school" of ophthalmology has given us many ophthalmic gifts in all phases of our subject, not the least of these is the present textbook, most beautifully illustrated.

What a pity so few of us can read German fluently. But at least we can really enjoy the illustrations.

Derrick Vail.

HAEMOPOIESIS, CELL PRODUCTION AND ITS REGULATION. Edited by G. E. W. Wolstenholme and M. O'Connor. Ciba Foundation Symposium, Boston, Little, Brown and Company, 1960. 490 pages, 107 illustrations, index. Price: $11.00.

This volume is a transcript of a symposium held in February, 1960, on the subject of hemopoiesis. A careful perusal of each paper fails to reveal any mention of the eye or any relationship of the blood-forming organs to ocular disease. This volume will be of interest to students of the eye in relationship to blood dyscrasias and other diseases of the hemopoietic organs. The average reader of THE JOURNAL will find little in this admirable but specialized symposium of interest to him.

David Shoch.

SIGHT: A HANDBOOK FOR LAYMEN. By Roy O. Scholz, M.D. Garden City, New York, Doubleday & Co., 1960. 166 pages, 13 diagrams, glossary. Price: $3.50.

The laity will find in this compact informative book a lucid discussion of the principal optical, medical and surgical conditions that affect the eye and vision. An intelligent person will understand his own ocular problem more completely from a leisurely reading of this book than from the hurried and often oversimplified explanation given by his busy ophthalmologist. The text presents clearly the structure and functions of the eye and the principal diseases to which it is subject. The instruments and techniques customarily employed in an ophthalmologic examination are briefly described, including the ophthalmoscope, tonometer, slitlamp microscope, Maddox rod and tangent screen. The answer to the question, what is an ophthalmologist, occupies a full page but neither here nor in the definition of optician is reference made directly or indirectly to optometry. This judicious omission of controversial material is characteristic and undoubtedly appropriate for a book of this type.

The handbook for the laity is up to date and thoughtfully written; it is indeed worthy of the glowing introduction by A. E. Maumenee. That such writing fills a need is evident from the recent demand for a second edition of Vail's contribution to the same field.

James E. Lebensohn.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Collier, L. H. **Observations on trachoma virus isolated in embryonate eggs.** Rev. Internat. Trachome **1**:57-64, 1959.

The author has isolated viruses similar to those described by previous Chinese workers by inoculating conjunctival scrapings from African trachoma patients into the yolk sac of embryonate eggs. Both African and Chinese groups are related to the psittacosis-lymphogranuloma virus. Koch's postulates were fulfilled by reproducing the disease in a human being and isolating again the virus in pure culture. (4 figures, 3 references)

Jose A. Ferriera.

Dereani, C., Jese, L., Jung, M., Kmet, J. and Murray, E. S. **The transmission of the inclusion producing agent of trachoma.** Rev. Internat. Trachome **1**:106-109, 1959.

Elementary inclusion bodies frozen and stored for ten months at −60° centigrade were inoculated into and recovered from the conjunctival scrapings of a volunteer.

Jose A. Ferriera.

Hogan, M. J., Yoneda, C., Feeney, L., Zweigart, P. and Lewis, A. **Morphology and culture of Toxoplasma.** A.M.A. Arch. Ophth. **64**:655-667, Nov., 1960.

The previous knowledge of Toxoplasma morphology is summarized and some new observations are described. Osmium-fixed organisms embedded in methacrylate were obtained four days after mouse inoculation and studied with the electron microscope. Toxoplasma were also inoculated into tissue cultures of retinoblastoma cells, fibroblasts, and HeLa cells and similarly studied. (9 figures, 37 references)

Edward U. Murphy.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

De Berardinis. E. **Hexokinase activity in beef retina.** Ophthalmologica **140**:193-200, Sept., 1960.

Hexokinase is the enzyme which catalyses the formation of hexose-6-phosphate from glucose and ATP, which is the first reaction in the glucose metabolism cycle. The author, interested in the different glycolytic enzymes of the retina, attempts to determine the hexokinase activity of retinal homogenates and the conditions under which maximum activity takes place. The rate with which free glucose disappears

from the homogenates is measured and used as an indication of activity. Maximal rates of disappearance occurred when the homogenate was incubated for 10 minutes at 30° C. in the presence of 0.002 M of glucose, 0.005 M of ATP, 0.04 M of KCl, and 0.0075 M of $MgCl_2$. Under these conditions glucose was consumed at the rate of 136 mcg. per 100 mg. of retinal homogenate (per 10 min.). (1 table, 4 figures, 10 references) Lawrence T. Post.

Friedman, Ephraim and Kupfer, Carl. **Transcorneal potential in vivo.** A.M.A. Arch. Ophth. **64**:892-869, Dec., 1960.

The electric potential difference (p.d.) across the cornea can be measured in the anesthetized rabbit by inserting an electrode into the anterior chamber. This p.d. is greatly affected by changes in the epithelium but not at all by endothelial changes, and is thus a transepithelial potential. The results in these experiments agree in polarity and magnitude with those reported in vitro. (5 figures, 5 references) Edward U. Murphy.

Gamstorp, I. and Kupfer, C. **Mean duration of action potentials in extraocular muscles.** A.M.A. Arch. Ophth. **64**:744-750, Nov., 1960.

In denervated muscle this was approximately twice that of normal muscle, while in myopathic muscle the duration was at the lower limit of normal. This measurement seems to be much more reliable than the amplitude and number of action potentials. (4 figures, 2 tables, 15 references) Edward U. Murphy.

Hanna, C. and O'Brien, J. E. **Studies on galactose cataract formation utilizing thymidinetritium.** A.M.A. Arch. Ophth. **64**:708-711, Nov., 1960.

Mice and rats placed on a galactose diet for 12 days were studied for alterations in desoxyribonucleic acid synthesis in the lens epithelium. The synthetic rate reached a maximum between four to six days. During this time the germinative area spread over the entire epithelium. (2 figures, 4 references) Edward U. Murphy.

Holland, M. G., Mallerich, D., Bellestri, J. and Tischler, B. **In vitro membrane potential of the cat ciliary body.** A.M.A. Arch. Ophth. **64**:693-696, Nov., 1960.

A bioelectric potential was measured across the cat ciliary body. Its magnitude was between +1.2 and +2.0 mv. with the stromal surface positive. (3 figures, 5 references) Edward U. Murphy.

Krill, A. E., Weiland, A. M. and Ostfeld, A. M. **The effect of two hallucinogenic agents on human retinal function.** A.M.A. Arch. Ophth. **64**:723-733, Nov., 1960.

The electroretinographic responses and dark adaptation curves were studied in 19 human subjects after hallucinogenic doses of JB 318 and LSD-25. The findings indicate that their effects are related to concomitant changes in retinal function. (3 figures, 5 tables, 36 references) Edward U. Murphy.

Münich, W. **Experimental studies on the action of β-radiation upon the absorption of P^{32} in rabbit's corneal tissue and its incorporation in acid-soluble phosphate fractions, particularly ATP and ADP.** Arch. f. Ophth. **162**:440-446, 1960.

The influence of β-radiation upon corneal metabolism was studied by following the fate of P^{32} which was injected subconjunctivally. The absorption of P^{32} increases according to the dosage of radiation but its incorporation into ADP and ATP is diminished. (3 tables, 33 references) Harri H. Markiewitz.

Paiva, C. **New antibiotics used in ophthalmology.** Arq. brasil. de oftal. **23**:126-128, 1960.

The author discusses several newer antibiotics which may be used in ophthalmology. Spiramycin, active against gram-positive bacteria and rickettsiae, has been

advocated as being effective against trachoma. The author has been unable to confirm this activity, however.

Kanamycin is indicated in staphylococcal infections when the organism is resistant to other antibiotics.

Soframycin seems promising in ophthalmology. It has a broad spectrum of activity, is highly soluble in water, and is well tolerated by the ocular tissues when administered subconjunctivally or intraocularly. It penetrates the blood-aqueous barrier readily and is effective against gram-positive cocci and gram-negative bacilli.

Colimycin and the fungistatic agents, Amphotericin B and Nystatin are discussed. James W. Brennan.

Potts, A. M. **Annual Reviews. Physiological chemistry of the eye.** A.M.A. Arch. Ophth. **64**:786-808, Nov., 1960.

The literature for 1959 is reviewed. (111 references) Edward U. Murphy.

Radnót, M. and Pajor, R. **Histological investigations on the effect exerted by alpha-chymotrypsin on the retina.** Acta ophth. **38**:583-586, 1960.

Alpha-chymotrypsin injected directly in front of the retina in rabbit eyes causes severe lesions. Depending on the amount of enzyme injected the structure of the retina becomes unidentifiable or disappears entirely and is replaced by fine or coarser scar tissue. (3 figures, 8 references) John J. Stern.

Saeteren, T. **Further investigations of aqueous vein flow in normal eyes after compression.** Acta ophth. **38**:496-510, 1960.

Several of the factors which determine the magnitude of the intraocular pressure in the undisturbed eye are changed after compression with 50 g and 16 g for four minutes. Using Mueller's electronic tonometer and Friendenwald's 1955 tables, it was found that during the first minute an increase of intraocular pressure occurred which was greater than what would be expected from increased aqueous volume. This is probably due to changes in blood volume and "creep." The rate of increase of the intraocular volume fell constantly after compression until the intraocular pressure attained the level of the venous pressure (10 to 11 mm. Hg). This may be explained by assuming that the venous pressure was reduced in the hypotonic phase following compression. (4 tables, 2 figures, 39 references) John J. Stern.

Saeteren, T. **The tonographic method for measuring aqueous flow.** Acta ophth. **38**:511-523, 1960.

The reliability of tonography is discussed and the numerous sources of error pointed out. It is doubtful whether the method yields correct values for rate of aqueous flow because the outflow pressure cannot be determined exactly. Tonography alters the pressure in the recipient blood veins and probably influences the scleral rigidity and the bulbar blood content. Aqueous production and outflow resistance are also probably altered during tonography. The extent of these errors is unknown and it is therefore impossible to evaluate the reliability of the results. Since the method causes marked changes in aqueous flow and resistance it can hardly be considered applicable for evaluating slight changes in these factors. (1 table, 2 figures, 59 references) John J. Stern.

Sears, M. L. and Barany, E. H. **Outflow resistance and adrenergic mechanisms.** A.M.A. Arch. Ophth. **64**:839-848, Dec., 1960.

In the rabbit eye Dibenamine increases and DCI decreases the outflow resistance. Excision of the superior cervical ganglion markedly lowers it at first, but later the resistance becomes supranormal. (2 figures, 2 tables, 22 references) Edward U. Murphy.

Sears, M. L. **Outflow resistance of the rabbit eye: technique and effects of acetazolamide.** A.M.A. Arch. Ophth. 64:823-838, Dec., 1960.

Mechanical cannulation and constant-rate infusions of rabbit eyes were used to study outflow facility. This work confirms earlier evidence that an increase in outflow resistance restores the intraocular pressure after acetazolamide-induced suppression of aqueous secretion. (7 figures, 3 tables, 33 references)

Edward U. Murphy.

Weekers, R., Lavergne, G., Feron, A. and Vermer, P. **Modifications with age of the aqueous secretion rate coefficient, measured by the suction cup method.** Ophthalmologica 140:215-222, Sept., 1960.

A suction cup, whose flange circumferentially contacts the sclera immediately adjacent to the limbus and thereby compresses the episcleral veins, is used to impede the outflow of aqueous humor. The change in Schiøtz readings over a given period of time serves as a measure of the increased ocular volume induced by the embarrassed aqueous outflow (for these calculations use is made of Friedenwald's tables for volume of corneal indentation). The procedure is not new, and the authors deal with the various objections to it at some length. Because of the likelihood that the suction cup does not prevent all outflow of aqueous, they refer to the secretory rate determined by this method as a "coefficient of secretion of aqueous." They believe that alterations in this coefficient may be of significance. Using this method, they find that there is a decrease of secretory rate with age. Since it has been variously reported that facility of aqueous outflow goes down with age, and since ocular pressure with time remains essentially the same, they reason that a decrease in aqueous flow must take place; this is cited as confirmation of their observations. They also discuss the reason why their figures for secretory rate are less than those calculated by Goldmann from fluorescein appearance times. However, they find that if they correct their calculation for a scleral rigidity coefficient of .0125 (as conveniently suggested by Prijot and Weekers), the two methods of determination come out about the same. This indicates to the authors that the suction cup technique may be more accurate than generally thought. (1 figure, 4 tables, 21 references)

Lawrence T. Post.

Ytteborg, Jan. **The effect of intraocular pressure on rigidity coefficient in the human eye.** Acta ophth. 38:548-561, 1960.

Rigidity coefficients were measured with an electromanometer at varying pressures on 29 enucleated human eyes. As intraocular pressure rose the coefficient decreased, particularly in eyes from older subjects. In-vivo measurements on nine human eyes showed the same average fall of the coefficient with increasing intraocular pressure but it was less pronounced than in enucleated eyes. This difference can be explained by the effect of the intraocular blood volume. (3 figures, 4 tables, 30 references)

John J. Stern.

Ytteborg, J. **Influence of bulbar compression on rigidity coefficients of human eyes, in vivo and enucleated.** Acta ophth. 38:562-577, 1960.

In eight human eyes tonography was performed before and after enucleation while the intraocular pressure was recorded continuously by an electromanometer. In four cases the results were good enough to allow a comparison; no difference in the decrease of pressure was observed with the two methods. In 84 eyes the rigidity coefficient was determined with applanation and weight tonometry, just before and after compression with a tonometer with a 5.5 g. weight

for one and one-half minutes. A significantly lower rigidity coefficient was found but the difference was reduced after five minutes. Similar compression in enucleated eyes gave a rise in rigidity coefficient. This is explained by the difference in intraocular blood volume; a lower rigidity coefficient is found because of an irritative hyperemia following compression. (2 figures, 5 tables, 35 references) John J. Stern.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Harrison, R., Hoefnagel, D. and Hayward, J. N. **Congenital total color blindness.** A.M.A. Arch. Ophth. **64**:685-692, Nov., 1960.

This defect was present in two brothers who were studied clinically. The accidental death of one provided opportunity for a pathologic examination. A marked lack of cones was noted in contrast to the only previously reported postmortem study. (3 figures, 20 references) Edward U. Murphy.

von Noorden, G. K. and Burian, H. M. **Perceptual blanking in normal and amblyopic eyes.** A.M.A. Arch. Ophth. **64**:817-838, Dec., 1960.

The perceptual time was found to be around 30 msec. and blanking occurred at 23 msec. The average values for these times were longer in the amblyopic eyes but apparently were not related to the depth of the amblyopia. (1 figure, 2 tables, 9 references) Edward U. Murphy.

5

DIAGNOSIS AND THERAPY

Agarwal, K. C. **Evaluation of inclusion bodies staining techniques.** Rev. Internat. Trachome **3**:269-279, 1959.

The Giemsa method is probably the most reliable, though time consuming; it is well supplemented by the iodine method of Rice, which demonstrates the glycogen matrix of the elementary inclusion bodies. (12 figures, 22 references) Jose A. Ferriera.

Dejean, C. and Benafid, S. **Subconjunctival injections of sulfonamides in the treatment of trachoma.** Rev. Internat. Trachome. **3**:282-291, 1959.

Soluseptazine and Solufontamid injected subconjunctivally gave better results than any other treatment including antibiotics. Jose A. Ferriera.

Fine, B. S. and Zimmerman, L. E. **Therapy of experimental intraocular Aspergillus infection.** A.M.A. Arch. Ophth. **64**:849-861, Dec., 1960.

Fungus infections seem to be increasing and are more difficult to treat than bacterial. The rabbit eye tolerated an intravitreal injection of Nystatin better than one of Amphotericin B and the efficacy of therapy in experimental infections depended on the time treatment was begun. Best results were noted when therapy was given 24 hours after inoculation of the spores. Earlier treatment was not as effective, possibly because of the time required for the spores to germinate. (12 figures, 18 references) Edward U. Murphy.

Jamieson, K. G., Sutherland, J. M. and Yelland, J. D. N. **Caroticocavernous fistula with contralateral signs.** A. & N.Z. J. Surg. **30**:128-130, 1960.

The patient, aged 74 years, had pulsating exophthalmos, third and sixth cranial nerve palsies and raised ocular tension on the left side. A bruit was heard on the right side and angiography showed a typical right carotid-cavernous aneurysm while left angiography was normal. Internal carotid ligation caused hemiplegia one and a half hours later. This disappeared on removing the ligature. Subsequently slow occlusion by a clamp was successful. Ronald Lowe.

Jensen, C. D. F., Lyda, Wood, Hargiss, J. L. and Petersen, W. C. **Modified eye speculum for aspiration.** A.M.A. Arch. Ophth. **64**:938-940, Dec., 1960.

A spiral needle may be added to the outer canthal hook of a Park speculum to permit continuous aspiration of fluid collecting in the conjunctival sac. (1 figure) Edward U. Murphy.

Kahán, A. and Pápai, I. **Efficiency of the terramycin eye salve.** Szemészet **97**: 206-210, 1960.

This eye salve is a mixture of one part of terramycin and two-thirds parts of chlorine hydrate. Its reaction is equal to that of the conjunctival sac. It may be dissolved with p_H 7,5 and so it is 12 times more soluble in water than the borateless terramycin having the same p_H value. This eye salve made with terramycin-borate secures higher and steadier terramycin levels in the conjunctival sac, than the salve made with terramycin dihydrate and its action on trachoma symptoms is better too. Its irritating effect lies between those of the terramycin chlorin-hydrate salve and the terramycin dihydrate preparation. A very efficient salve without any irritative effect could be made from factory processed terramycin borate instead of from the same compound, produced by double decomposition in the conjunctival sac. Gyula Lugossy.

Lugossy, Gy. **Electric erysiphake.** Szemészet **97**:228-232, 1960.

The erysiphake which may be attached to a forcing and sucking pump operated by electricity secures a suction force of 0-600 mm. Hg. The suction may be interrupted by a valve at any time. Thus almost in every case an intracapsular extraction may be secured by the erysiphake, except intumescent cataracts, which may be removed in the unimpaired capsule by expression. Gyula Lugossy.

Oksala, A. and Lehtinen, A. **Experimental observtaions on acoustic biomicroscopy of various parts of the eye.** Acta ophth. **38**:599-605, 1960.

Various parts of the bovine eye and opaque human lenses were examined with ultrasound equipment. Magnification of X 20 to X 40 was obtained by the use of a high-frequency oscilloscope. The highest resolving power was 0.2 mm. in depth and 0.5 mm. laterally. The healthy cornea, sclera, lens, aqueous and vitreous are acoustically homogeneous. (8 figures, 12 references) John J. Stern.

Papaleo, F. and Medrado, V. **Recent developments in general anesthesia as applied to ophthalmic surgery.** Arq. brasil. oftal. **23**:113-119, 1960.

Although most ocular surgery can be done with local anesthesia, there are instances where general anesthesia is preferable or essential. The author discusses various types of general anesthesia which may be used for minor procedures, extraocular surgery and those operations in which the globe is opened. Premedication, induction, and various anesthetic agents are discussed. In addition, he reports personal observations on the use of succinyl choline and its effects upon the ocular tension. Twenty patients having electroshock therapy were given an injection of the drug as a muscle relaxant. The ocular tension increased as much as 13 mm. of mercury in this series, confirming previous observations. The author concludes that this side effect makes it undesirable for intraocular surgery. (5 references) James W. Brennan.

Rostkowski, Louis. **Fight against trachoma in Poland.** Rev. Internat. Trachome. **2**:203-210, 1959.

Good results have been obtained in thirty years of fight against the disease. The choice of drugs is not so important as

the prophylaxis and regular treatment. Statistics show a fall from 1.5 percent to 0.2 percent. (13 references)

Jose A. Ferriera.

Stenström, W. J. **A modification of the new Zeiss fundus camera.** A.M.A. Arch. Ophth. **64**:935-938, Dec., 1960.

A change in the base will permit rapid consecutive exposures of adjacent horizontal fundus areas without the necessity of recentering the light. (5 figures)

Edward U. Murphy.

Tsutsui, Jun. **Achromycin in the treatment of trachoma.** Rev. Internat. Trachome **1**:73-84, 1959.

Achromycin in oil suspension of liquid paraffin was able to cure acute trachoma within a month with three instillations daily. 80 to 90 percent of the cases of chronic trachoma were cured in three months. In combination with hydrocortisone it was effective only in the early acute stages. (5 tables, 5 references)

Jose A. Ferriera.

6

OCULAR MOTILITY

Jonkers, G. H. **Statistics on deviations of binocular imbalance.** Ophthalmologica **140**:180-192, Sept., 1960.

Data from the records of 1,000 patients, chosen at random, suffering from muscle imbalances, suppression amblyopia, or strabismus, were coded and transferred to punch cards. Some 900 different data per patient could thus be coded. Simply as a sample of what information is readily at his fingertips, the author seeks the answers to several questions; these are tabulated, and the following conclusions are reached: 1. anisometropia is characteristically an accompaniment of suppression amblyopia (despite reports to the contrary elsewhere), the more marked refractive error being found in the amblyopic eye; 2. heredity plays a "not unimportant" role in amblyopia and strabismus; 3. the left eye is more frequently amblyopic than the right (2:1), and the left eye squints more frequently than the right; 4. of 572 cases of esotropia, 43 percent had ARC, 32 percent had NRC, and 17 percent had total suppression (the remainder were not accurately measured); ARC was very rare in association with exotropia; 5. in relating age of onset to nature of fixation, the median age of onset of the group of eccentric fixators lies at six to seven months, that of the ARC at two years, and that of the NRC at three years; 6. the refractive error in cases of esotropia is *not* significantly different from that of normal; 7. the profundity of amblyopia does not appear to relate to age of onset, and 8. divergent strabismus is rarely complicated by amblyopia (there was only one case of eccentric fixation in the series). (9 references)

Lawrence T. Post.

Nordlöw, W. **The angle of squint, amount of surgery and results of operation in constant convergent squint.** Acta ophth. **38**:524-547, 1960.

The material consists of 345 cases of convergent constant strabismus; in most of them operation was done early. They represent static angles of squint from 5 to 50°. The frequency is evenly distributed between 6° and 31°, with the exception of 9° to 10°. Between 30° and 37° it falls to half, to cease toward 50°. In 238 cases a guarded tenotomy plus resection on one eye was performed. The results agree with the theoretical values in 82.8 percent; a simple mechanical relationship may be assumed between the static angle of squint, amount of surgery and the result. Parallelism was obtained with only one operation in 52.5 percent; after one or two more operations it was obtained in 72.3 percent, cosmetically satisfactory results in an additional 16.8

percent and unsatisfactory results in 10.9 percent. In 107 cases with a static angle of squint of 5 to 16° guarded tenotomy on one eye was first performed. No single relationship between angle of squint, amount of surgery and result could be shown. Parallelism was obtained after one operation in 51.5 percent. After a second operation it occurred in 70 percent, cosmetically satisfactory results in 28 percent and unsatisfactory results in 1.9 percent. In the whole material vertical deviations occurred in 29.4 percent in cases in which the child had squinted at birth, and in 3.6 percent in patients which had started to squint after three months of age. After operation for the horizontal deviation the frequency of vertical squints showed good agreement with that before operation. (2 figures, 22 tables, 12 references)

John J. Stern.

Sokolić, P. **Some technical modifications of our double folding the eye muscle by simple suturing.** Acta ophth. **38**: 578-582, 1960.

The author describes in detail a simplification of a previously published method of folding the external rectus twice upon itself in order to shorten it. This improvement consists of the use of two instead of three sutures. (5 figures, 6 references) John J. Stern.

7

CONJUNCTIVA, CORNEA, SCLERA

Alberth, B. **The value of keratoplasty in the struggle against blindness.** Szemészet **97**:216-219, 1960.

There were 64 patients in the Ophthalmological Clinic of Debrecen who lost sight entirely because both corneas turned gray. By means of keratoplasty the author succeeded in making three patients capable of work and the vision of 11 patients improved to such a degree that they no longer needed the help of others. Forty patients remained blind. A great part of the cases was considered quite hopeless before the surgery and operation was performed only at the express wish of the patients. Gyula Lugossy.

Bölcs, S. **Hemorrhagic lymphangiectasis of the conjunctiva.** Szemészet **97**: 204-205, 1960.

The condition develops in the course of recurring conjunctival bleedings. It is mostly unilateral. The lymph vessels of the conjunctiva display cyst-like dilatation, their content is lymph mixed with blood. The condition is caused by two factors: local tendency to bleeding and pathologic anastomoses between blood and lymph vessels. Gyula Lugossy.

Burns, R. P. and Beighle, R. **Experimental carrageenin granuloma of the cornea.** A.M.A. Arch. Ophth. **64**:712-723, Nov., 1960.

This substance is a hydrocolloid extracted from the seaplant Irish moss and is a powerful stimulus to the production of collagen. Guinea pig cornea injection with carrageenin results in intense edema and collagen formation which gradually disappears after six weeks. This granuloma is a useful tool for the study of normal repair and connective tissue metabolism. (11 figures, 22 references)

Edward U. Murphy.

Cramer, F. K. and Lamela, N. **Experimental study of the effect of surface diathermy on scleral rigidity.** Arch. oftal. Buenos Aires **35**:81-84, March, 1960.

On the rather fragile basis of scleral rigidity determinations made with the method of paired tonometric readings obtained with different plunger loads in three rabbit eyes to which nonperforating retrociliary diathermy had been applied, the authors conclude 1. that E undergoes a drop which does not transcend the lower limits of the normal values previously en-

countered in the same animals, and 2. that their results are a confirmation of the generally accepted view that the scleral rigidity coefficient varies inversely with the intraocular pressure. (3 graphs, 7 references) A. Urrets-Zavalía, Jr.

Cremona, A. C., Alezzandrini, A. A. and Cassara, M. E. **Lamellar keratoplasty in the treatment of hypopion corneal ulcers.** Arch. oftal. Buenos Aires **35**:169-174, May, 1960.

Large therapeutic, lamellar corneal transplants were performed in six cases of severe, antibiotic-resistant corneal ulcer with hypopion. The results were invariably good in that the postoperative course was uneventful, the graft remained clear, and the vision, which in all cases had been reduced to light perception at the time of surgery, was recovered to an extent which varied from 0.1 to 0.7 (4 figures, 26 references) A. Urrets-Zavalía, Jr.

Funder, Wolfgang. **The influence of local application of vitamin A and panthenol on experimental corneal necrosis.** Arch. f. Ophth. **162**:430-439, 1960.

Having had encouraging clinical experience with vitamin A and panthenol in various corneal affections, the author investigated their action on necrotic corneal wounds produced by electrocoagulation. Stromal and epithelial healing was most rapid when these preparations were used, particularly vitamin A. Blepharoconjunctivitis, falling of lashes, and hyperemia were noticed as side effects. The authors conclude that the ointments are clinically useful in a number of corneal disorders, particularly those of traumatic origin. (4 figures, 2 tables, 10 references) Harri H. Markiewitz.

Lievkoieva, E. F. **Cytological studies in trachoma: its importance.** Rev. Internat. Trachome **3**:261-267, 1959.

From his longstanding research with tissue culture of trachomatous patients, the author concludes that the presence of cells of lymphoblastic origin points to a hyperplastic reaction rather than an inflammatory one; the degenerate lymphoblasts described by Thygeson seem to be young or atypical forms. (2 figures) Jose A. Ferriera.

Norn, M. S. **Cytology of the conjunctival fluid in new-born with references to Credé's prophylaxis.** Acta ophth. **38**:491-495, 1960.

In 120 eyes the reaction of new-born infants to Credé's prophylaxis was epithelial desquamation followed by neutrophilia for up to three days. Neutrophilia and purulent conjunctivitis after the fifth day is due to bacterial infection. (5 figures, 7 references) John J. Stern.

Palich-Szántó, O. **Infiltration of the cornea in the region of the arcus senilis.** Ophthalmologica **140**:161-167, Sept., 1960.

In the past three years, 65 cases of a peculiar form of corneal infiltration have been observed in the Johannes Hospital eye clinic in Budapest. The author believes it has not previously been described, although it is obviously not rare. The condition is seen only in individuals over 50 years of age and most cases occur in patients between the ages of 60 and 70 years. The disease is characterized by the acute onset of pain and foreign body sensation, ciliary injection, photophobia, tearing, swelling of the upper lid, and occasionally a mild iritis. In the majority of cases a gerontoxon is present, and directly overlying this, either forming a complete circle or several arcs of a circle, is a dirty-yellow infiltrate, over which the epithelium is lightly stippled. The infiltrates usually are in Bowman's zone, but occasionally invade the stroma quite deeply. Although a clear area of cornea separates the infiltrates from the limbus, the affected area is soon vascularized,

and, with the appearance of the blood vessels, the disease process starts to clear. The duration of the disease is usually 10 to 14 days, but in severe cases can be longer. The author differentiates the condition from EKC, ring abscess, and marginal dystrophy. Staphylococcic ulcers and infiltrates, and Mooren's ulcers are more briefly considered; the former, in the reviewer's opinion, is not adequately ruled out. Bacteriologic studies and animal injections proved negative, but secondary infection was thought to be of some importance. The author postulates a disturbance in fatty-acid metabolism in the arcus senilis, leading to vascularization and a consequent return of the metabolism to normal. Local silver nitrate, antibiotics and steroids are recommended for treatment. Dionine is used to promote more rapid vascularization. Scopolamine is given systematically for the iritis. (18 references) Lawrence T. Post.

Pék, L. **Clinical importance of intravascular aggregation.** Szemészet **97**:211-215, 1960.

In connection with 100 clinical cases the author studied the aggregation in the vessels of the conjunctiva. He calls attention to the circumstance that under general conditions this phenomenon may occur as a consequence of eye diseases too. Aggregation impairs tissue nourishing and it is of a prethrombotic character. Gyula Lugossy.

Rizzo Paolo. **Changes in corneal thickness due to trachomatous pannus.** Rev. internat. Trachome **1**:86-93, 1959.

The author found a uniform or a localized thinning of the cornea in the majority of the cases; however, some of them were either thicker or normal. (4 references) Jose A. Ferriera.

Rud, E. **Megalocornea in a Danish gypsy family.** Acta ophth. **38**:606-617, 1960.

Eight cases among 168 examined members of a gypsy family are reported. The inheritance was recessive x chromosomal. The gene can probably manifest itself with incomplete expression. The female carriers were sound. The presence of iris processes and a prominent ring of Schwalbe may support the theory that megalocornea is an atavism. (2 figures, 29 references) John J. Stern.

Schepens, C. L., Okamura, I. D., Brockhurst, R. J. and Regan, C. D. J. **Scleral buckling procedures.** A.M.A. Arch. Ophth. **64**:868-881, Dec. 1960.

Polyester fiber suture material was used in about 2500 cases and may advantageously replace silk as a nonabsorbable buried suture. The use of silicone implants with or in place of polyethelene tubing in over 1500 cases is reported and the surgical techniques described. Results obtained were superior than when polyethylene tubes are used alone. (8 figures, 31 references) Edward U. Murphy.

Zagora Edward. **Histopathology of a trachomatous giant cyst of Krause's gland.** Rev. Internat. Trachome **3**:334-339, 1959.

In this case the cyst became large enough to swell the upper lid; probably it was due to occlusion of the efferent duct by cytoplasmic debris. (4 figures, 6 references) Jose A. Ferriera.

8

UVEA, SYMPATHETIC DISEASE, AQUEOUS

Burian, H. M., von Noorden, G. K. and Ponseti, I. V. **Chamber angle anomalies in systemic connective tissue disorders.** A.M.A. Arch. Ophth. **64**:671-680, Nov., 1960.

Angle anomalies were found gonioscopically in patients with Marfan's syndrome, idiopathic scoliosis, Legg-Perthes disease, idiopathic genu varum, Osgood-Schlatter disease, and related disorders.

The anomalies consist of pectinate strands, fraying of the iris root, thinning of the last roll of iris, mound-like formations near the root of the iris, and abnormal vessels. It seems likely that arachnodactyly and other mesodernal disorders are the result of an inborn error of metabolism, probably of the mucopolysaccharides. (6 figures, 2 tables, 16 references) Edward U. Murphy.

Makley, T. A. and Leibold, J. E. **Modern therapy of sympathetic ophthalmia.** A.M.A. Arch. Ophth. **64**:809-816, Dec., 1960.

The treatment of this perplexing condition is reviewed from the recent literature and from experience with four cases treated since steriods became available. Early diagnosis, prompt steriod therapy, and long follow-up are stressed. Three of the four cases reported here responded favorably. (20 references)

Edward U. Murphy.

O'Rourke, J. **Hypometabolism and depressed thyroxine utilization in association with uveitis.** A.M.A. Arch. Ophth. **64**:734-743, Nov., 1960.

Many patients with uveitis show a reduced basal metabolism and a decreased capacity to utilize thyroxine. The significance of these findings is not clear and is discussed in relation to the adequacy of immune responses. Uveitis may be a form of systemic disease whose extraocular features remain undisclosed. (2 tables, 8 figures, 19 references)

Edward U. Murphy.

Vannas, S., Nordman, E. and Teir, H. **Uveitis resembling sympathetic ophthalmia induced by sensitization of intraperitoneally implanted eye.** Acta ophth. **38**: 618-634, 1960.

1. The material consisted of 35 albino rabbits. On 15 of them the own enucleated eye was implanted intraperitoneally; on five the eye of another rabbit was used. In the control group similar procedures were performed but instead of the eye, cartilage or fat was implanted. In addition, normal eyes of rabbits dead in anesthesia were used as controls. The eyes were removed after three weeks to five months for histologic work-up.

2. The eye in the peritoneal cavity had developed phthisis and a strong phagocytosis was observed. Mononuclear phagocytes and eosinophils were noticed especially in the uvea, the anterior sclera and the outer layers of the eye. The phagocytes had picked up also melanin granules. The lens was the most resistant but after five months even nonperforated lens was disintegrated.

3. In a half of the intact eyes in situ a slight or moderate aqueous flare was noticed. Infiltration of mononuclear cells and alterations of retinal pigment epithelial cells were found in 40 percent of these eyes.

4. In three out of 14 intact eyes in situ changes resembling an incipient sympathetic ophthalmia were observed; slow onset, granulomatous lesion of ciliary body with epithelioid and giant cells containing pigment grains and proliferation of retinal epithelial cells resembling Dalén-Fuchs nodules. No aqueous flare nor the cellular alterations mentioned were found in the control eyes.

5. Operative trauma of the eye in situ—iridencleisis or discission of the lens—performed one to four months after the implanation usually showed delayed and more severe postoperative reaction than in controls and suggested at least the sensitization to uveal tissue and lens.

6. These alterations produced for the first time on rabbits without the aid of bacteria or viruses point to the role of a combined sensitization as the cause of the sympathetic ophthalmia. (12 figures, 39 references) Author's summary.

Waksman, B. H. and Bullington, S. J. **Studies of arthritis and other lesions in-**

duced in rats by injection of mycobacterial adjuvant. III Lesions of the eye. A.M.A. Arch. Ophth. 64:751-762, Nov., 1960.

This report has great importance for the study of uveitis, since this poorly-understood ocular disease can now be produced in an experimental animal by systemic injection. A suspension of killed tubercle bacilli or Nocardia asteroides in mineral oil was the agent used. The uveitis occurred in 15 percent of injected rats as part of a syndrome which included arthritis, urethritis, colitis, and dermatitis. These lesions seem to represent an allergic response of the delayed hypersensitive type to constituents of the injected organisms. (6 figures, 2 tables, 35 references) Edward U. Murphy.

9

GLAUCOMA AND OCULAR TENSION

Blackstad, T. W., Sunde, O. A. and Troetteberg, J. **On the ultrastructure of the deposits of Busacca in eyes with glaucoma simplex and so-called senile exfoliation of the anterior lens capsule.** Acta ophth. 38:587-598, 1960.

Deposits of Busacca were studied with electron microscopy in unstained total mounts, replicas, ultra thin sections and specimens subjected to phosphotungstic "negative staining." The pictures confirm those of light microscopy. At the periphery of the tufts fine straight filaments, about 100 Å in diameter, occur in abundance. At the periphery and in the inner portions of the tufts, irregular fibers with a nonhomogenous interior and a diameter of 200 to 350 Å occur. A number of them are thinner and straighter, suggesting a relationship between the even and the irregular fibers. The constant and specific ultrastructure of the deposits invites the assumption of a specific macromolecular specificity and specific chemical properties. (37 micrographs, 16 references) John J. Stern.

Drance, S. M. and Woodford, V. R. **Clinical and biochemical studies of anthranilic acid as an ocular hypotensive agent.** A.M.A. Arch. Ophth. 64:668-670, Nov., 1960.

No decrease of intraocular pressure was found in normal or glaucomatous eyes treated with this drug and followed up to three months. The substance was shown to be a carbonic anhydrase inhibitor but markedly weaker than acetazolamide. (4 tables, 6 references) Edward U. Murphy.

Gimenez Almenara, J. **Our first experience with Tosmilen in the treatment of glaucoma.** Arch. Soc. oftal. hispano-am. 20:947-953, Aug., 1960.

This is a brief review of the chemical and pharmacologic properties of Tosmilen, a new German miotic, and a summary of the results in 33 cases in which it was used. Tosmilen is a powerful inhibitor of cholesterinase, and has a greater hypotensive effect than the other miotics. It requires much less frequent instillation for the maintenance of its effect. The author used it in one third, one half, and a one-percent solution, beginning with the weaker solution and increasing it if necessary for the normalization of intraocular pressure. The effect of one drop may last two to three days, and the effect is accumulative. The author's experience comprises 26 cases of chronic glaucoma, one of chronic congestive, two of acute, two of absolute, and two cases of secondary aphakic glaucoma. The results were satisfactory in chronic glaucoma. In the 26 cases of chronic glaucoma, twenty patients were treated unsuccessfully previously with pilocarpine, or had surgery which failed to control the intraocular pressure. The results were poor in the congestive, acute and aphakic cases. With one drop of Tosmilen every ten or fifteen days, and seven percent pilocarpine instilled at bedtime the ocular tension was also controlled in the two cases of absolute glaucoma. Ray K. Daily.

McGarry, H. I. **Annual reviews. Glaucoma, 1959-1960.** A.M.A. Arch. Ophth. **64**:951-971, Dec., 1960.

The literature from July of 1959 to July of 1960 is discussed. (239 references)

Edward U. Murphy.

Perkins, E. S. **Glaucoma in the younger age groups.** A.M.A. Arch. Ophth. **64**:882-891, Dec., 1960.

Over 3000 case histories form the basis of this report. There is a group of patients with open-angle glaucoma in which the age of onset is between 30 and 50 years and whose characteristics differ from the usual senile type. These cases show a predominance of males, a high incidence of myopia, and a high incidence of pigmentation of the trabeculae. The cause may be a developmental defect in the outflow channels and it seems likely that the pigmentation is not the primary cause of the glaucoma. (8 figures, 4 tables, 25 references) Edward U. Murphy.

Queiroga, G. **Recent developments in the surgical treatment of glaucoma.** Arq. brasil. oftal. **23**:120-125, 1960.

Surgical intervention in glaucoma is indicated when there is progressive loss of visual field and when the intra-ocular tension is not controlled by miotics. In general, two types of surgery are employed: reduction of aqueous secretion or increasing its outflow. Partial atrophy of the ciliary processes by physical methods such as diathermy diminishes the secretion.

Reestablishing or improving the evacuation of aqueous varies from an iridectomy in acute glaucoma to a fistulizing procedure or cyclo-dialysis in other types of glaucoma. The criteria for chosing the procedure vary with the type of glaucoma and the abnormality in the chamber angle. The failure of fistulizing procedures can be attributed in many instances to the formation of a cicatrix at the point of drainage. The use of diathermy on the lips of the scleral wound and the postoperative use of steroids may minimize the degree of scarring.

Carbonic anhydrase inhibitors, relaxing agents and tranquilizers administered preoperatively enhance the chances of success in surgery. (2 tables, 12 references)

James W. Brennan.

Simon Tor, Jose M. **Applanation tonometry.** Arch. Soc. oftal. hispano-am. **20**:935-946, Aug., 1960.

This is a description of the Goldmann applanation tonometer, and an explanation of its theoretical basis. Its advantages lead the author to conclude that this method will eventually replace to a large extent depression tonometry. It is pointed out that this method is not applicable to bed-ridden patients and children under anesthesia. It is also not suitable for experimental study on animals because it is calibrated for the human cornea. (4 figures, 5 references) Ray K. Daily.

Vannas, S. and Tarkkanen, A. **Some observations of glaucoma on hypophysectomized juvenile diabetics.** Acta ophth. **38**:635-639, 1960.

Two out of 11 severe juvenile diabetics, hypophysectomized for proliferative retinopathy, had chronic simple glaucoma three and four years after operation respectively. Three additional cases showed borderline tonographic values with a shorter follow-up period. One patient developed hemorrhagic glaucoma with rubeosis prior to hypophysectomy; two patients in a control group of seven had developed the same condition. None of the hypophysectomized patients had developed hemorrhagic glaucoma postoperatively. Two patients who had not been operated upon had narrow angles with normal outflow facilities; the fellow eye of one of them had hemorrhagic glaucoma with rubeosis; the other one had a normal open angle. Rubeosis is probably preceded by narrowing of the chamber angle. (2 tables, 7 references) John J. Stern.

10

CRYSTALLINE LENS

Arjona, J. **Results of surgery of congenital cataracts.** Arch. Soc. oftal. hispano-am. **20**:864-870, Aug., 1960.

This is a review of the literature with emphasis on the dangers of early surgery. The author belongs to the group of those who advocate delaying surgery until anesthesia is well tolerated, the globe has reached a certain degree of development, and cooperation on the part of the child is possible. The technique he prefers is a linear extraction, with suture of the wound. (9 references) Ray K. Daily.

Arruga, H. **Preoperative compression of the globe to obtain hypotension in cataract surgery.** Arch. Soc. oftal. hispano-am. **20**:841-844, Aug., 1960.

Chandler's procedure of following the retrobulbar injection by digital compression is very effective in reducing the ocular tension and adding to the safety of the cataract extraction. With a Baillart tonometer Arruga measured the pressure produced within the eye by the digital compression, and with a tube filled with shot he determined the weight required to reduce the intraocular pressure. He found that a pressure of less than 50 grams is inadequate; a pressure of 100 to 150 grams produced a marked hypotension, which appears more rapidly with a compression of greater weight. Since the degree and time of digital compression is variable, he advocates measuring the ocular tension with a tonometer until the desired degree of hypotension is obtained. The effect of compression is much more pronounced in old than in young people, and the hypotensive effect may last from 10 to 30 minutes. An intraocular pressure of less than 10 mm. of Hg assures safety of operation. (2 figures) Ray K. Daily.

Barraquer, J. and Rutllan J. **Experience with enzymatic zonulysis.** Arch. Soc. oftal. hispano-am. **20**:850-863, Aug., 1960.

The authors describe in detail the modifications in the description of enzymatic zonulysis formerly reported and evaluate the results on the basis of experience with 465 cases. It is confirmed that alpha-chymotrypsin in aqueous solution is very efficacious in dissolving the zonular fibers and their connection to the lens. The optimum concentration of the enzyme is 1:5000. Lysis is obtained at the end of one or two minutes. There are no secondary complications attributable to the surgery, if the technique and indications are carefully observed. The author believes that the complications reported by some surgeons such as striate keratitis, intense liberation of iris pigment, rupture of the limiting membrane of the vitreous, and secondary glaucoma have no relation to the effect of chymotrypsin and can be avoided by scrupulous attention to technique. The modifications in technique from that formerly reported consist of the making of the incision scleral with a large conjunctival flap adequate to cover the entire incision, extraction with a dilated pupil, irrigation of the lips of the wound with normal saline solution immediately after the introduction of the enzyme into the posterior chamber, irrigation of the anterior chamber with physiologic saline solution before extracting the lens, and instillation of acetylcholine into the anterior chamber after the lens extraction. From a tabulated review of his cases the author concludes that enzymatic zonulysis is suitable for all types of cataract, for transparent lenses in high myopia, and for angle-closure glaucoma. In patients between 20 and 60 years of age it is indicated as a routine procedure. In patients over 60 it is indicated in cases of intumescent cataract, in high myopia and when zonular resistance is suspected. In patients between 10 and 20 years of age it is very useful, although the operation is difficult. In patients under 10 years of age it should be used only in experimental

cases because a technique for overcoming the surgical difficulties has not as yet been developed. In a series of 10 cases the author tried to leave the chymotrypsin in the globe for longer periods of time up to 15 minutes with a resulting marked increase in the complications. (1 figure, 4 tables, 7 references) Ray K. Daily.

Dolcet, L. **Surgical indications for cataract extraction in infants.** Arch. Soc. oftal. hispano-am. **20**:871-880, Aug., 1960.

Reference is made to François' exhaustive study on this subject which brought out the poor results of early surgery. Dolcet presents his views on the controversial question of timing and technique in surgery for infantile cataract. He defines infantile cataract as a lenticular opacity, partial or total, congenital or acquired, progressive or stationary, which reduces visual acuity to 20/200. This low degree of visual acuity is considered as a surgical indication. It is pointed out that in infants under three years of age it is impossible to determine the visual acuity. Regardless of the type of etiology of the lenticular anomalies they are divided from a surgical standpoint into three classes; bilateral cataract, cataract in one eye and a lenticular opacity permitting a visual acuity better than 20/200 in the fellow eye, and unilateral cataract. In unilateral cataract, or cataract in one eye with an opacity in the other, surgery is not urgent. Surgery before the age of five should not be considered in cases in which in addition to the cataract there are other unilateral or bilateral ocular congenital malformations. In bilateral total cataracts with no other ocular anomalies the author advocates surgery at about the age of one year in one eye, delaying surgery in the second eye to the age of four or five. In eyes with no light reflex it is preferable to delay surgery until the age of two years. (2 figures, 11 references)
Ray K. Daily.

Hockwin, O. **Study of phosphate metabolism of lenses by ion exchange chromatography.** Arch. f. Ophth. **162**:339-345, 1960.

Lenses obtained from calves' eyes were treated with P^{32} and studied by a combination of ion exchange chromatography with radiometric methods. This has the advantage of permitting insight both into the stationary concentration of intermediate metabolic products and their kinetics. The empiric results thus obtained are tabulated. (1 figure, 2 tables, 19 references) Harri H. Markiewitz.

Kleifeld, O. and Hockwin, O. **The significance of oxygen to the metabolism of the lens.** Arch. f. Ophth. **162**:346-349, 1960.

On the basis of experimental data and certain presuppositions, the authors attempt to elucidate quantitatively the influence of oxygen on sugar metabolism and energy production of the ox's and the rabbit's lens. Oxygen consumption was determined by a polarographic method previously described by the authors.

Increased supply lead to increased utilization of oxygen and slight depression of glycolysis, with probably advantageous influence on the energy household (ATP production). (1 table, 11 references)
Harri H. Markiewitz.

Moreno-Lupianez, Ernesto. **Cataract extraction with a limbal conjunctival flap cut with scissors and Barraquer's subconjunctival suture.** Arch. Soc. oftal. hispano-am. **20**:845-849, Aug., 1960.

The technique which is advocated for its ease and safety comprises a conjunctival flap cut with scissors 6 mm. from the limbus and reflected over the cornea, cauterization with a hot glass rod of the bleeding points, a 5 mm. incision into the anterior chamber with a keratome, completion of the incision at the limbus with Castroviejo scissors and insertion of two corneo-scleral sutures of virgin silk, one of which is used as a security suture by

tying to its free end a small piece of silk suture. After extraction of the lens three additional corneo-scleral sutures are inserted and the conjunctival flap is closed with interrupted sutures. (8 figures, 3 references) Ray K. Daily.

von Noorden, G. K., and Schultz, R. O. **A gonioscopic study of the chamber angle in Marfan's syndrome.** A.M.A. Arch. Ophth. **64**:929-934, Dec., 1960.

Mesodermal chamber angle anomalies were present in all 12 cases examined. Their severity generally corresponded with the degree of systemic involvement. (3 figures, 2 tables, 23 references) Edward U. Murphy.

Paiva, C. **Experiences with the Barraquer technique for cataract extraction.** Arq. brasil. oftal. **23**:135-139, 1960.

The author reports his observations in a series of 45 cataract extractions following a technique which he calls Barraquer's although there are three individuals credited with procedures. The incision and suture of José Barraquer are used, the phakoeresis of Ignacio, and the zonulolysis of Joaquim—all Barraquer. The use of physiologic saline solution instead of air is advocated to restore the anterior chamber since it reestablishes the hydrodynamics of the eye and does not disturb the iris. The author concludes that enzymatic zonulolysis permits as high as 97 percent success in delivering the cataractous lens within its capsule. (5 figures) James W. Brennan.

Tapasztò, I. **Demonstration of mucopolysaccharides in the lens.** Arch. f. Ophth. **162**:350-358, 1960.

The author reports his method of the experimental analysis of the various components of the lenticular mucopolysaccharide—protein complexes and its results. Clear lenses of human, ox, and pigs' eyes as well as cataractous human lenses, were examined. Following electrophoresis the material was treated with pepsin and trypsin and the products submitted to another paper-electrophoretic analysis. Chemical methods were employed to identify the individual fractions in the papers.

The lens capsule seems to contain relatively more mucopolysaccharides than equal quantities of cortical or nuclear matter. Six fractions of mucopolysaccharides could be isolated from human lenses and four from those of oxen and pigs. Most of the mucopolysaccharides of intact lenses migrate faster than those of cataractous lenses. There is also a numeric difference between the mucopolysaccharide fractions of intact and cataractous lenses when these are digested with pepsin for 24 hours. (4 figures, 3 tables, 14 references) Harri H. Markiewitz.

11

RETINA AND VITREOUS

Bohár, A. and Csanda, E. **Experimental data on the pathomechanism of degeneratio pigmentosa retinae.** Szemészet **97**: 193-203, 1960.

The authors evoked degeneratio pigmentosa retinae in rabbits by NaJA in the way well known from the literature. They followed the stages of the histologic changes by fundus examinations and histologic studies. They examined with methods of acute and chronic vital staining the permeability of the blood vessels. The results showed that the choroid already manifested a distinct increase of permeability in the acute stage in respect of the order of magnitude of the vital staining. This phenomenon is quite in keeping with the severity of the edema. The histologic desintegration was found to be the gravest in the outer layers of the retina in the immediate vicinity of the choroid. Penetrating inwards into the strata of the retina the changes got milder. Pigment cells or cells containing stains migrated

from the direction of the choroid into the outer strata of the retina. All this seems to show that the NaJA exerts a lasting toxic effect upon the chorio-capillaries. This effect is unprovable by routine histologic examinations but it can be proved by vital staining. The above mentioned observations raise again Wagenmann's theory, who held that degeneratio pigmentosa retinae is a primarily choriocapillary disease. Gyula Lugossy.

Kirschner, R. and Leopold, I. H. **Retinal changes in the alloxan diabetic rat maintained on high fat diet.** A.M.A. Arch. Ophth. **64**:681-684, Nov., 1960.

A simplified silver nitrate injection technique is described which stains the entire retinal vasculature of the rat. Twelve alloxan diabetic rats showed no retinopathy after three months. Four of six animals receiving a high fat diet in addition showed changes suggestive of early aneurysmal retinopathy. (3 figures, 26 references) Edward U. Murphy.

Küper, J. and Müller-Limmroth, W. **The electroretinogram and adaptability in retinitis pigmentosa—with a contribution to the theory of the extinguished ERG.** Arch. f. Ophth. **162**:359-368, 1960.

The purpose of this study was to examine the relationship between the ERG and dark adaptation in cases of tapetoretinal degeneration. In 25 cases of diffuse tapetoretinal degeneration it was shown that when the ERG was extinguished dark adaptation too practically disappeared. The ERG, though, was found to have been the far more sensitive indicator of the degenerative process. This seemed to indicate that the ERG is not a product of photoreceptor activity alone.

The author attempts to correlate the electric findings with the anatomic substrate and available histo-pathologic pictures of retinitis pigmentosa, whereby particular significance is attached to Bruch's membrane. (6 figures, 42 references) Harri H. Markiewitz.

Kuwabara, Toichiro, and Cogan, D. G. **Studies of retinal vascular patterns. Part I. Normal architecture.** A.M.A. Arch. Ophth. **64**:904-911, Dec., 1960.

A new method of preparation is described in which the nonvascular components of the retina are digested prior to staining. (10 figures, 14 references) Edward U. Murphy.

Missotten, L. **Study of the rods of the human retina by electron-microscopy.** Ophthalmologica **140**:200-214, Sept., 1960.

This publication consists of an anatomic description of the ultrastructure of retinal rods. The reproduction of photomicrographs is good. The text is detailed. No immediate, clinical application of the information derived is suggested. (7 figures, 28 references) Lawrence T. Post.

Sedan, J. and Bourde, C. **A successful cure of a central retinal artery obstruction by immediate use of heparin.** Ann. d'ocul. **193**:905-913, Nov., 1960.

A 79-year-old woman was seen by the authors with complete obstruction of the central retinal artery. Her vision at this time was no light perception, and there was a complete obstruction of the central retinal artery. Neither mild nor firm pressure on the globe resulted in any pulsation, and a cherry red spot became apparent in the macular zone. Anticoagulants in the form of heparin were instituted immediately as well as numerous other drugs which are given only by trade-name. These include Tromexane, Hydroserpan, Hydergine, and Dissolvurol. The patient made a remarkable recovery and at the end of 24 days vision had returned to 5/10. Visual fields gradually returned to normal, and the vision has remained good over a period of two

years since the original accident. (1 figure, 13 references) David Shoch.

Vancea, P. and Tudor, E. **Progressive familial macular degeneration.** Ann. d'ocul. **193**:914-920, Nov., 1960.

The authors report two brothers with progressive macular degeneration of the Stargardt type. There was a characteristic loss of central vision, loss of color vision, but good night vision and a normal peripheral field. The description of the macular changes is rather typical for this disease. (4 figures, 14 references)

David Shoch.

Widder, Wolfgang. **Hyaluronic acid as a vitreous implant in retinal detachment; experimental principles.** Arch. f. Ophth. **162**:416-429, 1960.

The surgical treatment of retinal detachment by implantation of various substances into the vitreous cavity is recapitulated. Hyaluronic acid of cattle vitreous was investigated for its chemical and physical properties as well as metabolic features. It was found to have a higher viscosity than human vitreous and would thus be expected to remain longer as an implant in the vitreous cavity. Thirty-one such implantations were performed on the eyes of 18 rabbits with minimal complications. As a result of this exemplary systematic investigation, the clinical transplantation of human vitreous after Shafer was abandoned in Dr. Hruby's department and hyaluronic acid was substituted. (1 figure, 2 tables, 69 references)

Harri H. Markiewitz.

12

OPTIC NERVE AND CHIASM

Hoyt, W. F. **Charcot-Marie-Tooth disease with primary optic atrophy.** A.M.A. Arch. Ophth. **64**:925-928, Dec., 1960.

A case of this rare genetically determined neurological disease characterized by severe muscular atrophy is reported. There was progressive late visual loss due to optic nerve involvement. Visual fields showed bilateral cecocentral scotoma. (3 figures, 15 references)

Edward U. Murphy.

Kranenburg, E. W. **Crater-like holes in the optic disc and central serous retinopathy.** A.M.A. Arch. Ophth. **64**:912-924, Dec., 1960.

The 123 cases in the literature of the past 75 years and 24 cases from the Amsterdam University Eye Clinic were studied. Far from being an innocuous ophthalmoscopic finding, this congenital abnormality seems to be related to the colobomatous defects. There is a characteristic papillo-macular visual field defect and an association of central serous retinopathy in at least half the cases. The author postulates an increased vulnerability of the macular area to various noxious agents based on the local anatomical defects. (11 figures, 1 table, 40 references)

Edward U. Murphy.

Wolter, J. R. **Regenerative potentialities of the centrifugal fibers of the human optic nerve.** A.M.A. Arch. Ophth. **64**:697-707, Nov., 1960.

Eleven days after enucleation for retinoblastoma, the optic nerve stump was obtained during an exenteration. Histologic study showed numerous surviving nerve fibers and definite evidence of axon regeneration toward the eye. These findings are evidence for the existence of centrifugal nerves in the human optic nerve. (15 figures, 10 references)

Edward U. Murphy.

13

NEURO-OPHTHALMOLOGY

Lund, O.-E. **Histologic and morphogenetic studies of the eye and brain in phacomatoses.** Arch. f. Ophth. **162**:369-399, 1960.

A detailed and well illustrated correlative study of the histologic and embryologic features of phacomatoses is reported. In neurofibromatosis (v. Recklinghausen) and tuberous sclerosis (Bourneville) the structures affected are mostly neuroectodermal (neuromas of the uvea and bulbus, pigment granules of the iris; glioblastomas of the disc margin and retina). In encephalotrigeminal angiomatosis (Sturge-Weber) and angiomatosis retinae et cerebelli (v. Hippel-Lindau) the pathology is confined mostly to mesodermal tissue (angiomas and teleangiectasias; angioblastomas).

The genetic period during which the initial changes must occur is given between the first and fourth embryonal month. The similarity of the pictures in the eye and brain, as well as the existence of transitional forms, justifies the incorporation of the syndromes into the single entity of the phacomatoses. (18 figures, 92 references)

Harri H. Markiewitz.

Mackensen, G. and Schumacher, J. **The velocity of the rapid phase of the optokinetic nystagmus.** Arch. f. Ophth. **162**: 400-415, 1960.

While the slow phase of the optokinetic nystagmus was shown to depend on the velocity of the stimulus, this paper deals with the velocity pattern of the rapid phase. The horizontal nystagmus, produced by the drum on two healthy subjects, was recorded electrooculographically. From a slow start the motion accelerates to a peak and then declines, to gradually transform into the slow phase. The peak is reached before the temporal and spacial midpoint of the motion, so that acceleration is always greater than retardation. The results are independent of stimulus frequency but vary according to the direction of motion. It is concluded that the pattern of ocular motility during the rapid phase of the optokinetic nystagmus resembles that of gaze movements. (17 figures, 2 tables, 8 references)

Harri H. Markiewitz.

Orteza, Josefine. **A case of ependymoma simulating Devic's syndrome.** A.M.A. Arch. Ophth. **64**:940-945. Dec., 1960.

The clinical signs of neuromyelitis optica were simulated by an ependymoma of the cerebellum with diffuse subarachnoid spread and leptomeningeal gliomatosis. (8 figures, 7 references)

Edward U. Murphy.

Palomar-Petit, F. and Ley-Gracia, A. **Campimetric data on pituitary adenomas treated surgically or by irradiation.** Arch. Soc. oftal. hispano-am. **20**:905-909, Aug., 1960.

In this analysis of 25 case histories of pituitary adenomas the authors emphasize the changes of the visual fields following surgery or irradiation therapy. The cases are classified as to the type of tumor, preoperative or pre-irradiation and postoperative and post-irradiation visual fields. A favorable prognosis is indicated by youth of the patient, the symmetry of campimetric changes, partial bitemporal anopsias and bitemporal central scotomas, and rapidity of development. In general recovery of the visual fields is rapid in rapidly developing cases, and in slowly developing cases it is slow. Unfavorable signs are advanced age of the patient, asymmetry of field changes, involvement of the nasal fields, and prolonged or intense compression of the optic pathways. (Visual fields of the 25 cases.)

Ray K. Daily.

14

EYEBALL, ORBIT, SINUSES

Bangerter, A. **A simple implant for enucleations and eviscerations.** Ophthalmologica **140**:172-179, Sept., 1960.

In an earlier publication (Ophthalmologica 132:262-270, 1956), the author ad-

vanced a technique for using a ball of nylon thread as an implant in conjunction with either an enucleation or an evisceration. In this article he discusses complications which have arisen from this procedure and how they can best be avoided and corrected. The surgical technique is again described, with emphasis on those steps of the procedure which are important in preventing the complications mentioned. (4 figures, 1 reference)

Lawrence T. Post.

Charleux, J. **The palpebral and orbital manifestations of neurofibromatosis.** Ann. d'ocul. **193**:930-962, Nov., 1960.

This is a general review of the subject of von Recklinghausen disease particularly as it affects the lid and orbit. In the first part of the article the author describes the three types of tumors found in the lid which may be included in this entity. They are the typical plexiform neuroma, the palpebral neuroglioma and palpebral dermatolysis.

The major portion of the article is devoted to the orbital manifestations of von Recklinghausen disease, and these are divided into those of the tissues of the orbit exclusive of the optic nerve and neurofibromatosis of the optic nerve itself. Finally the author considers true osseous tumors of the orbit and secondary extension into the orbit from intracranial tumors. (13 figures, 24 references)

David Schoch.

15

EYELIDS, LACRIMAL APPARATUS

Acźel, G. **The surgical correction of cicatricial entropion.** Ophthalmologica **140**:168-171, Sept., 1960.

A case of long-standing, severe, trachomatous, cicatricial entropion is described, which was greatly benefitted by plastic operations on the lids: a mucous membrane graft was used for the lower lids; a Kettesy lid plastic procedure was performed on one upper lid, and a graft of cartilage from the ear was taken for the other. These operations are discussed, the last in some detail. No illustrations of the surgical procedures are included. (2 figures, 3 references) Lawrence T. Post.

Busse Grawitz, P. **Orientating investigations into the chemistry of the inflammatory factors ("degradation factor") in the lacrimal fluid.** Arch. f. Ophth. **162**: 447-454, 1960.

Inflammatory cells in the cornea originate from preexisting stromal elements, and for this metamorphosis a specific state of over-nutrition and a special hypothetic "factor" are prerequisite. This "factor" is said to be produced by the inflamed conjunctiva and transmitted into the lacrimal fluid. Activity of the factor is histologically demonstrable through the reaction at the margins of central corneal wounds. The influence of various additions to the lacrimal fluid on experimental corneal wounds in the rabbit was investigated, in the belief that the results project the chemical features of the "degradation factor." (1 figure, 12 references)

Harri H. Markiewitz.

Gimenez Almenara, Julian. **Dacryocystorhinostomy.** Arch. Soc. oftal. hispanoam. **20**:881-902, Aug., 1960.

An exhaustive description of the author's preoperative surgical and postoperative management. The operation is performed on patients from 8 to 55 years of age. A thorough preoperative study of the patient and normalization of general hypertension, coagulation, bleeding time, and vascular fragility are essential. Anticoagulants are administered preoperatively for five days. Anesthesia is local with potentialization when necessary in adults, and general with intubation and nasal packing in children. A good light and aspirator are important. The surgical

technique comprises an incision 3 mm. from the internal angle, trephining with Gutzeit burrs, suture in two planes if possible, a suture left in the lacrimal duct if passage of the probe is difficult, irrigation of the surgical field with penicillin and a continuous skin suture. Postoperatively penicillin-streptomycin for three days and anticoagulants are administered. With this pattern of management the author's satisfactory results were from 98 to 75 percent. (3 figures, 33 references)

Ray K. Daily.

16
TUMORS

Dollfus, M. **Melanotic tumors of the lids and conjunctiva and their treatment.** Arq. brasil. oftal. **23**:129-134, 1960.

Pigmented naevi of the lids and conjunctiva are fairly common and may require no treatment. The author discusses the points of differentiation between the benign and malignant pigmented lesions which occur. Although the majority of authors feel that a biopsy of a cutaneous melanoma is dangerous, this opinion does not prevail in regard to extra-ocular naevi or melanomas.

Relatively small tumors, less than 15 mm. in extent, localized to the lids or bordering on the conjunctiva can be treated by radiation. The local injection of cesium eosinate sensitizes the tissue to radiation and reduces the amount of radiation required for therapy.

Conjunctival lesions may be excised carefully after preliminary electrocoagulation of the nutrient vessels and encircling the lesion with a barrier of electrocoagulation. The use of the light coagulator may also be effective in treating this type of tumor.

Extensive lesions, or those recurring after radiation, require exenteration by electrocoagulation.

At one time a mortality rate of 90 percent could be expected. However, the above methods have resulted in a five-year cure in 75 percent of the patients who have been treated.

James W. Brennan.

Hunter, W. S. **Aberrant intra-ocular lacrimal gland tissue.** Brit. J. Ophth. **44**: 619-625, Oct., 1960.

Early aberrant ingrowth of lacrimal buds into the mesoderm adjacent to the rim of the optic cup may involve the limbus, ciliary body, and iris. Shortly after birth a gradually enlarging solid or cystic mass may be seen. This is the fourth case described. (5 figures, 14 references)

Irwin E. Gaynon.

Joyce, A. **Recent trends in the treatment of intra-ocular cancer.** A. & N.Z. J. Surg. **30**:117-122, 1960.

The author reviews British, American and Australian treatment of retinoblastoma. He uses tiny gold radon seeds sutured permanently to the sclera and positioned following very accurate preoperative ophthalmoscopic localisation of the tumors. Lack of surrounding retinal reaction has permitted the use of dosage of 12,000 r over an area 1 cm. in diameter. Seven cases are described.

Malignant melanomas of the choroid occurring in only eyes may be treated by radon seeds. Four cases are presented.

Ronald Lowe.

Valu, L. and Kereszturi, S. **Epibulbar primary reticulum cell lymphosarcoma.** Szemszet **97**:170-173, 1960.

In the reported case generalised diseases of the lymph nodes were excluded by clinical symptoms and laboratory findings, wherefore the epibulbar growth was considered a primary tumor. After biopsy, exenteration of the orbit was done. One year later neither recurrence nor generalisation was observed. Gyula Lugossy.

17
INJURIES

Csapody, I. and Erőss, S. **Management of wound disruption, and wound closing U-sutures.** Szemeszet 97:129-134, 1960.

Prolapse usually requires prompt intervention. Rarely is waiting more correct than the active procedure. In the case of early or late prolapse and when the vitreous body appears during the operation, corneo-conjunctival U-sutures proved to be very good. Gyula Lugossy.

McCaslin, M. F. **The management of intraocular foreign bodies.** A.M.A. Arch. Ophth. 64:482-493, Oct., 1960.

This subject is discussed from the standpoints of preoperative preparation, localization, magnets, surgical approach, and end results. The problems encountered in private practice are stressed. (9 figures, 39 references)

Edward U. Murphy.

Szabó, Gy. **Removal of non-magnetic foreign bodies piercing the cornea.** Szemészet 97:220-228, 1960.

The author describes a new and simple way of removing nonmagnetic foreign bodies such as chips and thorns piercing the cornea and getting to the anterior chamber. He performed experiments on rabbits and guinea pigs to observe the mechanism and pathologic-anatomic conditions of the operation. He connected a 150 cc. syringe by a thick-walled, 40 mm. long rubber tube to an eye-dropper pipette with a 2 to 3 mm. opening. The end of the pipette is set on the surface of the cornea so as to surround the outer orifice of the puncture channel. The suction effect brought forth by the syringe creates a negative pressure rise, which presses out the foreign body through the channel together with the aqueous humor. The results show that by means of this procedure such foreign bodies can very easily be removed; their removal required rather serious surgical interventions before sometimes causing grave complications. Foreign bodies which have got stuck in the puncture channel or at the inner end of it (rust, very thin chips, for example) can be removed by this method too. By means of the operation the exudate occurring on the back surface of the cornea and even hypopyon may be sucked out, because the hypopyon, being loosened by the aqueous humor streaming in its direction, is made suitable to aspiration. Hereby the healing will be quicker and undisturbed, promoted by the higher antibody content of the aqueous humor which is now reproduced in greater quantities. Gyula Lugossy.

Woillez, M. **The treatment of hemorrhages into the anterior chamber in contusions of the globe.** Ann. d'ocul. 193:921-929, Nov., 1960.

The author states that in very large hyphemas and where there is an increase in intraocular pressure, surgical intervention is mandatory. He feels that one should make a large keratome incision with lavage of the anterior chamber and evacuation of clots. Air should then be injected into the anterior chamber. He illustrates the beneficial results of this treatment with six cases. He particularly emphasizes the importance of injection of air into the anterior chamber after such surgical procedures, and feels that this more than anything else is responsible for the good results. (11 references)

David Shoch.

Zimmerman, A. and Merigan, T. C. **Retrobulbar hemorrhage in a hemophiliac with irreversible loss of vision.** A.M.A. Arch. Ophth. 64:949-950. Dec., 1960.

The clinical findings suggested closure of the central retinal artery from a massive retrobulbar hemorrhage initiated by mild trauma to the eye. All light percep-

tion was lost and an optic atrophy soon became evident. (2 references)

Edward U. Murphy.

18

SYSTEMIC DISEASE AND PARASITES

Cello, R. M. **Ocular manifestations of coccidioidomycosis in a dog.** A.M.A. Arch. Ophth. **64**:897-903, Dec., 1960.

The histologic changes in the eye of a dog with disseminated coccidioidomycosis are described. The granulomatous uveitis found to be present may be similar to the changes occurring in human cases. (6 figures, 16 references)

Edward U. Murphy.

Gally, J. and Jarry, D. **Some remarks on a new case of autochthonous filariasis.** Arch. d'opht. **20**:293-294, April-May, 1960.

The authors report the case of a man of 50 years who had lived in Tunis from 1912 to 1947 and in 1959 was found to have a subconjunctival filarial worm. The worm was extracted under local anesthesia and identified as Loa loa. A discussion of ocular filariasis follows but no references are included. P. Thygeson.

Laffers, Z. and Bozsóky, S. **Endogenous proteus panophthalmitis.** Szemészet **97**: 235-242, 1960.

The authors report on a case of endogenous panophthalmitis originating from proteus sepsis. The first manifestation of the sepsis was the panophthalmitis. The proteus bacillus (Proteus mirabilis) was isolated in vivo from the conjunctiva and from the vitreous body. The aqueous humour proved to be sterile. The proteus strain has been grown from blood, urine, duodenal juice and from tonsils, post mortem from the spleen, gall-bladder and from the purulent kidney. The source of the sepsis, the pyonephrosis was only cleared by the autopsy findings. The proteus strain culture proved to be sensitive to streptomycin and tetran also. In spite of adequate antibiotic therapy the 72-year-old patient afflicted also with diabetes and arteriosclerosis, died of cardiovascular insufficiency. Bacillus proteus figures more and more frequently as a cause of exogenous, postoperative panophthalmitis, but as witnessed by this case it can provoke endogenous panophthalmitis too. Gyula Lugossy.

Mathur, S. P. **Ocular complications in Molluscum contagiosum.** Brit. J. Ophth. **44**:572-573, Sept., 1960.

Molluscum contagiosum is a skin disease caused by a large virus which is somewhat contagious and which may affect the lids, conjunctiva and cornea. The lesion may simulate trachoma and if the diagnosis is made it is easily treated by excision and carbonization. The author briefly describes four cases of this disease of the skin of the face with the usual ocular complications. (1 figure, 4 references)

Morris Kaplan.

Muzzio, J. C. **Ocular sarcoidosis.** Arch. oftal. Buenos Aires **35**:96-101, March, 1960.

This is a discussion on the pathology and clinical picture of sarcoidosis, followed by the report of the case of a 30-year-old woman, who in addition to a hard, painless infarction of the salivary glands, the spleen, and the cervical and inguinal lymph nodes, presented bilateral dense corneal opacities (presumably the consequence of severe keratoiridocyclitis) with secondary glaucoma. Chest X-rays showed a marked mediastinal adenopathy. There was a definite increase in the erythrocyte sedimentation rate, but apparently no significant change in the albumin-globulin ratio. Biopsy studies made from material obtained from both the lacrimal and the parotid glands confirmed the diagnosis of sarcoidosis. Treatment with ACTH in daily doses of 20 IU given in-

travenously brought about practically no improvement at the end of three weeks. 70 references) A. Urrets-Zavalia, Jr.

von Noorden, G. K., Zellweger, H. and Ponseti, I. V. **Ocular findings in Morquio-Ullrich's disease.** A.M.A. Arch. Ophth. **64**:585-591, Oct., 1960.

Two cases are here added to the 15 previously reported. These individuals show the classical Morquio features but also have corneal clouding. (4 figures, 28 references) Edward U. Murphy.

Schen, R. J. **Myxoedema in enophthalmos.** Brit. J. Ophth. **44**:567-569, Sept., 1960.

In hypothyroidism there is frequently an edema of the lids which gives the impression of enophthalmos but occasionally a true enophthalmos occurs in this disease. The author describes a 60-year-old woman who developed a spontaneous myxoedema in which rather marked enophthalmos measuring 4 mm. was seen. (1 figure, 4 references)

Morris Kaplan.

Spencer, W. H. and Hoyt, W. F. **A fatal case of giant-cell arteritis (temporal or cranial arteritis) with ocular involvement.** A.M.A. Arch. Ophth. **64**:862-867, Dec., 1960.

One optic nerve showed a zone of ischemic necrosis immediately behind the lamina cribrosa. The other optic nerve had no necrosis but the same granulomatous inflammatory changes were apparent in the surrounding short posterior ciliary arteries, several of which were occluded. The ophthalmic arteries were similarly involved. Apparently both blood supplies to the optic nerve must be affected to produce severe ischemia and clinical loss of vision. (5 figures, 9 references)

Edward U. Murphy.

19

CONGENITAL DEFORMITIES, HEREDITY

Collier, M. **Congenital hyperplasia of the left semi-lunar fold and associated anomalies.** Ann. d'ocul. **193**:897-904, Nov., 1960.

The left eye of a 49-year-old woman is described in which there was a very large semilunar fold resembling a nictitating membrane. Associated anomalies included an imperforate lower lacrimal punctum, bilateral nevi of the iris and a pigment deposit on the disc with a situs inversus of the vessels. There was also some pigmentation of the conjunctiva. A second case is reported in which there was pigmentation of the cornea in both eyes associated with a pigmented nevus of the semilunar fold. (5 figures, 27 references)

David Shoch.

Schultz, R. O. and Burian, H. M. **Bilateral jaw winking reflex in association with multiple congenital anomalies.** A.M.A. Arch. Ophth. **64**:946-949, Dec., 1960.

This is the eighth reported bilateral case and the first to have coexisting systemic congenital anomalies. There was absence of the third digit and metacarpal of each hand, bilateral pes cavus, spina bifida, undescended testicles, and reduplicated incisors. Gonioscopic examination showed extensive abnormalities of the periphery of the iris similar to those seen in systemic mesodermal anomalies. (6 figures, 12 references)

Edward U. Murphy.

20

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Ferreira, L. **Codification of ocular diseases.** Arq, brasil. oftal. **23**:41-48, 1960.

The author presents a system of abbreviations which may be used in the codifi-

cation of diseases of the eye and its adnexa. In most cases an anatomic classification is followed but a clinical classification is used when the former is impractical. James W. Brennan.

Rocha, H. **The development of the ophthalmologist in Brazil.** Arq. brasil. de oftal. **23**:61-90, 1960.

The author discusses at length the training of an ophthalmologist, residency programs and didactic courses, and the influence of various American teachers and institutions upon the evolution of Brazilian ophthalmology. Special tribute is paid the late Dr. Moacyr Alvaro who worked so diligently in raising the standards of the specialty.

James W. Brennan.

Sloane, A. E. and Rosenthal, P. **School vision testing.** A.M.A. Arch. Ophth. **64**: 763-770, Nov., 1960.

This still unsettled topic is discussed from the standpoint of its history, the present situation, and recommendations for the future. There is a great lack of uniformity in most aspects of this problem, such as methods of testing and standards for referral, and it is hoped that the ophthalmologists will find the time to aid in its clarification. (46 references)

Edward U. Murphy.

Stankovic, I. and Ljubisa, M. **Some points of a mass campaign against trachoma.** Rev. Internat. trachome **1**:5-53, 1959.

Trachoma today presents a more benign symptomatology than in earlier years. This should not be a reason for a relaxation in the worldwide fight against the disease. Social, economic and climatic conditions are most important. To achieve successful results, an experienced and organized staff of physicians and auxiliary services must be trained. Treatment should be free and accessible to every patient. An outline of such organization is presented. (5 figures, 82 references)

Jose A. Ferreira.

Tower, Paul. **Books that made ophthalmological history.** A.M.A. Arch. Ophth. **64**:771-785, Nov., 1960.

The original works of some of the early authors in ophthalmology are here described and the title pages reproduced. The earliest is by George Bartisch from the year 1583 and provides a remarkable insight into Renaissance eye surgery. Ophthalmology has a rich and fascinating history and whether the practitioner knows it or not, everything he does is influenced by what his predecessors did, said, and wrote. (11 figures, 32 references)

Edward U. Murphy.

Varga, L. **Ignác Hirschler (1823-1891).** Szemeszet **97**:178-186, 1960.

The author deals with the biography of Hirschler. Reviewing of Hirschler's activity is quite inseparable from the foundation and upswing of Hungarian medical science. He was a manly, steadfast, and highly gifted warrior for his principles. He deserves credit for promoting the Hungarization of the Hungarian Jews and fighting bravely for equality before the law. He was one of the most talented, striking, and unselfish characters not only of Hungarian ophthalmology but of Hungarian public health. Gyula Lugossy.

NEWS ITEMS

EDITED BY DONALD J. LYLE, M.D.
411 Oak Street, *Cincinnati, Ohio*

News items should reach the editor by the 10th of the month. For adequate publicity, notice of postgraduate courses and meetings should be received three months in advance.

DEATHS

Dr. John Malcolm Tindal, Chicago, Illinois, died October 20, 1960, aged 62 years.

ANNOUNCEMENTS

COURSE IN ORTHOPTICS

The basic course in orthoptics for technicians, sponsored by the American Orthoptic Council, will be held in the Department of Ophthalmology, The University of Michigan Medical Center, Ann Arbor, Michigan, from June 26th to August 18th. As usual, there will be didactic lectures and practical demonstrations given by an outstanding faculty. At least three months of practical training should precede the course. For further information as well as application blanks write to John W. Henderson, M.D., Department of Ophthalmology, University of Michigan Medical Center, Ann Arbor, Michigan.

ROCHESTER GRADUATE COURSE

The summer graduate course in ophthalmology at the University of Rochester School of Medicine and Dentistry will be held on August 7th, 8th, 9th, and 10th. The first two days will be devoted to lectures on glaucoma, keratoplasty, intraocular foreign bodies, slitlamp problems, strabismus and ocular muscles, and medical ophthalmology. The third day will be largely devoted to refraction techniques and problems. The fourth day will be optional, a visit to Bausch and Lomb Optical Company, or a surgical clinic.

The faculty will be augmented by the following guest lecturers: August 8th, Dr. Peter Kronfeld, Chicago; Dr. Ramon Castroviejo, New York; and Dr. Harvey Thorpe, Pittsburgh. August 9th, Dr. Goodwin Breinin, New York; Dr. Edward Dunlap, New York; and Dr. George Wise, New York. August 10th, Dr. Murray McCaslin, Pittsburgh; Dr. Bernard Gettes, Philadelphia; Mr. Irving Lueck, Bausch and Lomb Optical Company, and Dr. Albert Snell, Jr., Rochester, New York.

The tuition fee for the course will be $60.00. This covers tuition, bus fares to and from the hospital, and the banquet Monday night, August 7th. Twenty dollars ($20.00) is payable with registration. The remainder of the fee will be payable on matriculation, Monday, August 7th. Registration, with check, payable to the director, John F. Gipner, M.D., should be mailed to the Strong Memorial Hospital, Rochester 20, New York.

SEMINAR ON GLAUCOMA

A seminar on glaucoma with particular emphasis on gonioscopy and the study of the anterior angle will be given at the Brooklyn Eye and Ear Hospital on May 15th, 16th, and 17th. Ample opportunity for practical instruction in the use of the gonioprism will be given and material from the glaucoma clinic will be utilized. The course will be given by Dr. Daniel Kravitz, assisted by Drs. Nicholas P. Tantillo and Samuel Zane. Registration is limited to six ophthalmologists only. Application and the fee of $50.00 may be addressed to Dr. Daniel Kravitz, Brooklyn Eye and Ear Hospital, 29 Greene Avenue, Brooklyn 38, New York.

OPHTHALMOLOGISTS WANTED

American Board qualified or certified ophthalmologists are wanted for unlimited ophthalmologic surgery for four to eight-week periods in Vietnam. Room and board in the Far East will be provided. Round-trip transportation must be borne by the ophthalmologist himself; however, these expenses, along with other incidental travel expenses, may be deducted from U. S. Federal income tax. For further information, write to Dr. William John Holmes, 280 Alexander Young Building, Honolulu 13, Hawaii.

SLITLAMP BIOMICROSCOPY

A postgraduate seminar in biomicroscopy, gonioscopy and applanation tonometry with new developments in the surgery of intraocular foreign bodies and cataract, will be given by the Department of Ophthalmology, Montefiore Hospital, Pittsburgh, from Monday, April 17th through Thursday, April 20th, under the direction of Dr. Harvey E. Thorpe and 15 associates. Instruction will be by illustrated lectures, clinical demonstrations and practice with the new instruments in this field under direct supervision of instructors. On the guest faculty will be Dr. Robert J. Masters, Indianapolis; Lee Allen, Iowa City; Samuel Berman, New York. The fee for the course or any part of it is $110.00. Check should be made payable to Montefiore Ophthalmic Postgraduate Courses. Attendance is limited to 40 ophthalmologists.

Application blanks may be obtained from A. T. McNabb, Secretary, Ophthalmic Postgraduate Committee, 206 Iroquois Building, Pittsburgh 13, Pennsylvania.

MOORFIELDS RESEARCH SCHOLARSHIP

The Moorfields Research Scholarship for 1962, of the value of approximately £300 sterling, will be awarded for the best essay written on the subject "The clinical value of tonometry and tonography." The prize is open to all nationalities, and the essay should be sent to the Director of Research, Institute of Ophthalmology, Judd Street, London, W.C.1, England, before July 31, 1962. The essay

must be presented in the English language and should be signed by a motto or a pseudonym, and accompanied by a sealed envelope containing the name of the author, the motto to be shown on the outside.

Research in prevention of blindness

The Committee on Basic and Clinical Research of the National Society for the Prevention of Blindness invites requests for research grants in 1961. Funds are available for projects that may contribute to basic understanding of eye function and pathology, or that may improve methods of diagnosis, treatment or prevention of blinding eye disease. Grants will be made this spring for requests received prior to April 1st, and inquiries can be addressed to Committee on Basic and Clinical Research, National Society for the Prevention of Blindness, 1790 Broadway, New York 19, New York.

Washington Hospital center

The Saturday morning lectures to be given during May at the Washington Hospital Center include: May 6th, "Cyclovertical and incomitant deviations," Dr. Frank D. Costenbader and Dr. Marshall M. Parks; May 13th, "Esotropia," Dr. Costenbader; May 20th, "Exotropia," Dr. Costenbader; May 27th, "Special groups," Dr. Dan G. Albert and Dr. Costenbader.

Basic course in ophthalmology

The Chicago Ophthalmological Society in cooperation with the Departments of Ophthalmology of the Chicago Medical School, Northwestern University Medical School, Stritch School of Medicine, University of Chicago School of Medicine, University of Illinois College of Medicine, various Chicago Hospital Centers and Cook County Graduate School of Medicine announces a comprehensive residency preparatory and review course called a "Basic course in ophthalmology" to begin July 10th and continue through December 8th. Address all inquiries to Registrar, Cook County Graduate School of Medicine, 707 South Wood Street, Chicago 12, Illinois.

Miscellaneous

Ophthalmic research grants

The National Council to Combat Blindness, Inc., the Fight for Sight, 41 West 57th Street, New York, New York, announces that its Board of Directors has allocated for the fiscal year 1960-61, $230,000 for awards to advance and support ophthalmic research, and $30,000 for support of clinical service projects, for a total of $260,000. This is the largest amount made available by the organization in a single year.

Out of this sum, the Scientific Advisory Committee of the organization, has to-date, approved projects totaling $232,258. The current distribution of funds is financing 32 grants-in-aid, 10 postdoctoral fellowships, one postgraduate fellowship, 31 student fellowships and four special awards, which include two clinical service projects pertinent to research study.

Fight for Sight grants-in-aid and full-time research fellowships are generally awarded for a period of one year, and may be renewed with the approval of the Scientific Advisory Committee of the National Council to Combat Blindness. Student fellowships are awarded for a two- or three-month period to selected students of medicine and the basic sciences, offering them the opportunity to engage in research between semesters.

Two additional members have joined the organization's Scientific Advisory Committee, which now numbers 26 eye physicians and scientists. The new members are Goodwin M. Breinin, M.D., chairman, Department of Ophthalmology, New York University-Bellevue Medical Center, New York; and Harold G. Scheie, M.D., chairman, Department of Ophthalmology, University of Pennsylvania School of Medicine, Philadelphia.

Other members of the Committee are: Charles A. Perera, M.D., chairman, New York; James H. Allen, M.D., New Orleans; Bernard Becker, M.D., Saint Louis; Hermann M. Burian, M.D., Iowa City, Iowa; Frederick Crescitelli, Ph.D., Los Angeles; Arthur G. DeVoe, M.D., New York; Dan M. Gordon, M.D., New York; W. Morton Grant, M.D., Cambridge, Massachusetts; Charles Haig, Ph.D., New York; Michael J. Hogan, M.D., San Francisco; V. Everett Kinsey, Ph.D., Detroit; Peter C. Kronfeld, M.D., Chicago; Irving H. Leopold, M.D., Philadelphia; A. E. Maumenee, M.D., Baltimore; John M. McLean, M.D., New York; Stuart Mudd, M.D., Philadelphia; Frank W. Newell, M.D., Chicago; Edward W. D. Norton, Miami; Theodore C. Rush, Ph.D., Seattle; Samuel L. Saltzman, M.D., New York; George K. Smelser, New York; Bradley R. Straatsma, M.D., Los Angeles; Kenneth C. Swan, M.D., Portland Oregon; Phillips Thygeson, M.D., San Francisco.

One of the clinical service projects is providing funds to aid in the establishment and maintenance of a children's eye clinic at Columbia-Presbyterian Medical Center, New York. This is believed to be the first eye clinic exclusively designed for children in a general hospital in the eastern United States, and the second in the entire nation. In addition to providing a valuable public service, it is felt that this eye clinic for children will make possible the collection of data concerning many relatively unknown eye diseases of children and will contribute toward developing a group of eye physicians particularly versed in pediatric ophthalmology.

Leslie Dana medal

The National Society for the Prevention of Blindness has announced that the 1960 Leslie Dana Gold Medal has been awarded to Dr. Frederick C. Cordes, San Francisco, for "distinguished contributions to the practice, teaching, research and literature in the field of ophthalmology." In 1925, Mr. Leslie Dana of Saint Louis, Missouri, established the award for meritorious work in the field of prevention of blindness and sight conservation.

Societies

Southern Medical Association

At the recent meeting of the Southern Medical

Association in Saint Louis, Missouri, the following officers were elected for the Section on Ophthalmology and Otolaryngology for the coming year: Chairman, Dr. Miles L. Lewis, Jr., 1539 Delachaise Street, New Orleans, Louisiana; chairman-elect, Dr. Samuel D. McPherson, Jr., 1110 West Main Street, Durham, North Carolina; vice-chairman, Dr. Claude D. Winborn, 3707 Gaston Avenue, Dallas, Texas; secretary, Dr. Albert C. Esposito, First Huntington National Bank Building, Huntington, West Virginia. The next meeting of the Section will be held in Dallas, Texas, November 6th to 9th. Those interested in participating should write to the secretary, Dr. Albert C. Esposito, First Huntington National Bank Building, Huntington 1, West Virginia.

Midwestern Section meeting

The Midwestern Section of the Association For Research in Ophthalmology will meet at the University of Kansas Medical Center, Wahl Hall Auditorium, 39th and Rainbow Boulevard, Kansas City, Kansas, on April 29th and 30th. The meeting will begin promptly at 9:00 A.M. on Saturday morning. The chairman of program and of local arrangements is L. L. Calkins, M.D., University of Kansas Medical Center, Rainbow Boulevard, at 39th Street, Kansas City 12, Kansas. T. F. Schlaegel, Jr., M.D., Indianapolis, is secretary of the Section.

Georgia meeting

The annual meeting of the Georgia Society of Ophthalmology and Otolaryngology was held at the General Oglethorpe Hotel, Wilmington Island, Savannah, Georgia. Among the guest speakers were Dr. Edwin B. Dunphy, Boston, Dr. Charles Iliff, Baltimore, and Dr. Dwight Townes, Louisville, Kentucky.

Oxford congress

The 46th annual meeting of the Oxford Ophthalmological Congress will be held in the School of Physiology Lecture Hall, South Parks Road, Oxford, on Monday, Tuesday and Wednesday, July 10th, 11th and 12th. The Doyne Memorial Lecture will be delivered on Tuesday morning by Dr. Macdonald Critchley, London, who will speak on "Reading disorders of central origin." The first of two discussions will be on "Trends in trachoma and allied infections," and will be opened by Sir Stewart Duke-Elder, Mr. Barrie R. Jones and Dr. Lister Collier, London. Openers for the second discussion, on "Ocular complications of head injuries," will be Mr. J. M. Small, Birmingham, Mr. A. A. Jefferson, Sheffield, and Mr. J. S. Groves, Coventry. Further information may be obtained from Ian C. Frazer, honorary secretary and treasurer, 21 Dogpole, Shrewsbury.

Philadelphia meeting

On the ophthalmic program of the Philadelphia sectional meeting of the American College of Surgeons were: "Symposium on recent advances in ocular surgery," John M. McLean, New York; Robert J. Brockhurst, Boston; W. Banks Anderson, Durham, North Carolina; Algernon B. Reese, New York; and William F. Hughes, Chicago. "Symposium on pediatric ophthalmology," Harold F. Falls, Ann Arbor, Michigan; John R. Fair, Augusta, Georgia; Frank D. Costenbader, Washington, D.C.; A. Edward Maumenee, Baltimore; Francis Heed Adler, Philadelphia; and Trygve Gundersen, Boston.

Nonoperative clinics in ophthalmic surgery were held at Wills Eye Hospital and Jefferson Medical College Hospital. Dr. Robert D. Mulberger was moderator of the discussions on "Diagnosis and treatment of uveitis," Joel B. Chodes and H. E. Chodos, and "Plastic procedures of the orbit," Gerard M. Shannon, Philip G. Spaeth and Robert D. Mulberger. Dr. Carroll R. Mullen was moderator for the discussion on "Some pediatric problems in ophthalmology." Papers presented at the nonoperative clinics at Temple University Hospital and the Hospital of the University of Pennsylvania were: "Intraocular surgery: Recent trends in preoperative and postoperative care," Robison D. Harley; "Dacryorhinostomy: Summerskill technique," Lewis R. Wolf; "Surgical planning for esotropia," Glen Gregory Gibson; "Crucial points in technique for cataract extraction," John McGavic; "Glaucoma surgery," Harold G. Scheie; "Complications of lens surgery from the point of view of the pathologist," William C. Frayer.

French congress

The 68th Congress of the Société Française d'Ophthalmologie will be held May 7th through 11th in the Centre Marcelin Berthelot, 28 bis, rue St. Dominique, Paris. The annual report will be given by Drs. Ourgaud and Etienne on "Functional examinations in glaucoma." The following special topics will be discussed at length: "Vitreous body and aqueous humor" and "Lacrimal apparatus."

XIX International Congress of Ophthalmology

The XIX International Congress of Ophthalmology will convene at New Delhi, India, from December 3 through 7, 1962. The subjects for reports and symposia are:

Reports: (1) "Tropical parasitical diseases of the eye," Prof. B. N. Bhaduri (Calcutta), Prof. Cyro De Rezende (São Paulo) and Prof. A. Larmande (Algiers), speakers; (2) "Corneal degenerations," Prof. G. B. Bietti (Rome), Prof. A. G. Leigh (London), Prof. A. Edward Maumenee (Baltimore), speakers. Others may take part in discussion.

Symposia: (1) "Complications of cataract operation," Prof. L. Paufique (Lyons), in charge; Prof. H. D. Dastoor (Bombay), and others to be selected by Prof. L. Paufique; (2) "Eales' disease," Prof. L. P. Agarwal (New Delhi), in charge; (3) "Electronic microscopy in ophthalmology," Prof. J. François (Ghent), in charge; (4) "Ophthalmologic problems caused by the progress of aviation," Prof. Conrad Berens (New York), in charge.

A complete brochure containing information on symposia, reports, films, accommodations, cultural program, banquet, tours and itineraries, is under preparation and will be dispatched shortly to members who have sent in their cards. The hotel accommodations will be arranged according to the wishes of the members by the organizers at New Delhi. Any other specific information which a member may desire may be obtained from the Secretary General, Dr. Y. K. C. Pandit, Bombay Mutual Building, Sir P. M. Road, Bombay 1, India.

Wills meeting

The Arthur J. Bedell Lecture was presented by Dr. Michael J. Hogan, San Francisco, during the 13th annual clinical conferences of the Wills Eye Hospital, Philadelphia. The subject of Dr. Hogan's address was "Cyclitis." Other papers presented were "Penetrating corneal transplant following excision of a limbal tumor," O. A. Capriotti and W. E. Fry; "Experimental implants of collagen sponge material in rabbit eyes," Robert D. Mulberger and Paul L. Carmichael; "Comparative cycloplegic effects of Mydriacyl with other cycloplegic agents," Bernard C. Gettes and Owen Belmont; "Surgical results following the recession-resection operation in intermittent exotropia," E. Howard Bedrossian; "Symposium on recent advances in treatment of uvetis," Joseph W. Hallett, Michael I. Wolkowicz, I. H. Leopold, Jack Berebitsky and Romeo V. Fajardo.

"Present status of photocoagulation in clinical ophthalmology," Edward J. Cannon; "Enzymatic zonulolysis as an aid in cataract surgery: A follow-up report on 432 cases with several hundred additional cases," Patrick J. Kennedy, James S. Jordan, Joseph F. Morrison, Robert D. Mulberger and Stanley W. Boland; "Persistent primary vitreous: A case report," Charles G. Steinmetz, III; "Rhabdomyosarcoma in the child," Edmund B. Spaeth and Albert F. Cleveland; "Prechiasmal syndrome associated with bilateral cerebral aneurysms," Nathan S. Schlezinger; "Postoperative pseudomechanical intestinal obstruction following eye surgery," Harold A. Hanno; "Retinal detachments associated with glaucoma: Preoperative and postoperative management," L. Sarin, J. Chessen, W. Annesley, Jr., and P. R. McDonald; "A method for removal of hypermature lens," Harold D. Barnshaw; "Intravenous and oral urea," William Tassman; "The surgical correction of entropion," Gerald M. Shannon.

Gill meeting

The 34th annual spring congress of the Gill Memorial Eye, Ear and Throat Hospital, Roanoke, Virginia, will be held April 3rd through 8th. Ophthalmologists on the faculty will be: Dr. Rudolf Aebli, New York; Dr. Windsor S. Davies, Detroit; Dr. R. M. Fasanella, New Haven, Connecticut; Dr. Thomas R. Hedges, Philadelphia; Dr. Arthur Linksz, New York; Dr. Bernard Schwartz, Brooklyn; Dr. Frederick H. Theodore, New York; Dr. H. P. Wegener, Rochester, Minnesota; and Dr. James E. Purnell, New York.

Toronto meeting

Sir Benjamin Rycroft, London, and Dr. Robert N. Shaffer, San Francisco, were the guest surgeons at the recent eye surgery clinical meeting of the Division of Postgraduate Medical Education, University of Toronto Faculty of Medicine. Three symposia were held during the meeting. Dr. G. A. Thompson was chairman of the first on "Keratoplasty." Chairman of the second symposium on "Children's eye diseases," was Dr. J. S. Crawford. Dr. J. C. McCulloch was chairman of the symposium on "Cataract extraction." Preceding the clinical conference, an all-day departmental research meeting was held at the Eye Department, Toronto General Hospital. Dr. Hermann M. Burian, Iowa City, Iowa, was guest of honor. He spoke on "Accommodative esotropia," and "Strabismic amblyopia: New views and experimental results."

Personals

Dr. Harold G. Scheie, Philadelphia, has been elected a second vice president of the American College of Surgeons.

Dr. William B. Clark, New Orleans, spoke on "Common eye problems," at the annual clinical conference of the Chicago Medical Society.

Dr. Frederick C. Cordes, San Francisco, has been re-elected a regent of the American College of Surgeons for a term of three years.

Dr. Francis Heed Adler, Philadelphia, has been awarded the 1960 Howe Medal of the University of Buffalo for his outstanding contributions in the field of ophthalmology. Dr. Adler has already received the Howe Medal of the American Ophthalmological Society and the Medal of the Section of Ophthalmology, American Medical Association, for his distinguished service to ophthalmology.

Dr. John S. Speakman, F.R.C.S.(C), Department of Ophthalmology, University of Toronto, received the Annual Award in Surgery at the 30th annual meeting of the Royal College of Physicians and Surgeons of Canada held at the Chateau Laurier, Ottawa. Dr. Speakman received the award for his essay on "The structure of the trabecular meshwork and corneal endothelium in relation to the problem of resistance to outflow in open-angle glaucoma."

Dr. Alston Callahan, Birmingham, Alabama, was the guest speaker for the Faculty of Ophthalmology, University of Louisville School of Medicine, on January 23rd. Dr. Callahan's paper on "Advances in ophthalmic surgery" was followed by a question and answer period and discussion.

Dr. Frank W. Newell, Chicago, recently presented a paper before the Section on Ophthalmology, College of Physicians of Philadelphia. The subject of his address was "The management of ocular malignancy."

CHICAGO OPHTHALMOLOGICAL SOCIETY 1961 ANNUAL CLINICAL CONFERENCE

May 19 and 20, 1961 — **The Drake Hotel, Chicago, Illinois**

PRELIMINARY PROGRAM

GUEST SPEAKERS:

Count H. Arruga, Barcelona, Spain
Bernard Becker, M.D., St. Louis, Mo.
Joseph S. Haas, M.D., Chicago, Illinois
William F. Hughes, M.D., Chicago, Ill.
Peter C. Kronfeld, M.D., Chicago, Ill.
Mr. A. G. Leigh, London, England
Frank W. Newell, M.D., Chicago, Ill.
Irving Puntenney, M.D., Chicago, Ill.
Harold G. Scheie, M.D., Philadelphia, Pa.
Robert N. Shaffer, M.D., San Francisco, Calif.

SUBJECTS:

Retinal Detachment
Corneal Surgery
Symposium: "Surgery and Medical Therapy of Narrow and Open Angle Glaucoma"
Symposium: "Secondary Glaucoma"
Other subjects to be announced

Fee: $45.00 (Includes Round Table Luncheons and Dinner following Gifford Lecture)
Registrar: Mrs. Mary E. Ryan, 1150 North Lorel Avenue, Chicago 51, Illinois

THE SEVENTEENTH ANNUAL GIFFORD MEMORIAL LECTURE

Dr. Harold G. Scheie, Philadelphia, Pennsylvania
Friday, May 19, 1961, The Drake Hotel
5:15 P.M.

The Chicago Ophthalmological Society extends an invitation to all physicians to attend the Lecture
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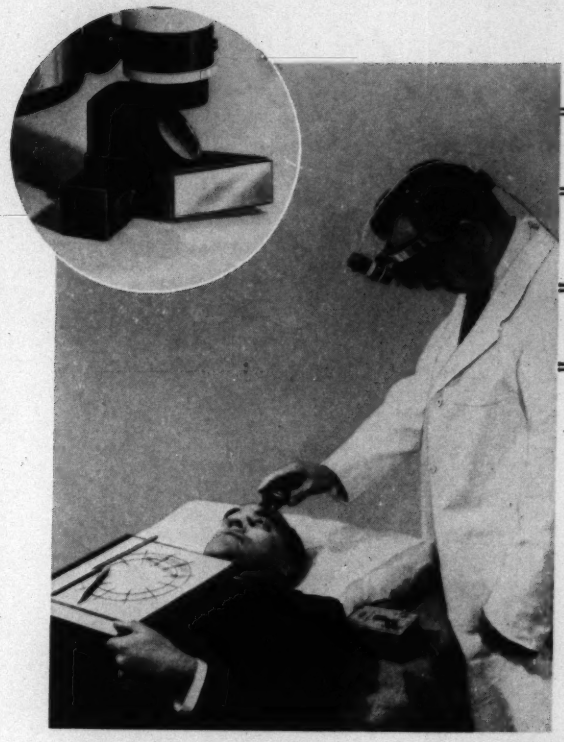

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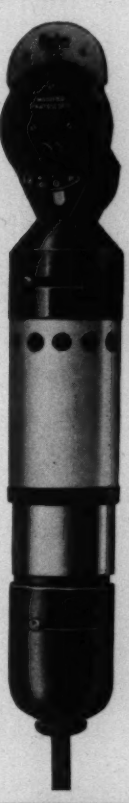

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